The New Zealand
Journal of Agriculture.

VOL. 51. WELLINGTON, 20TH NOVEMBER, 1935. No. 5.

THE LIME-REQUIREMENTS OF SHEEP.*

THE LIMITATIONS OF OUR KNOWLEDGE.

M. C. FRANKLIN, Canterbury Agricultural College, Lincoln.

MUCH work has been done during the last ten or twenty years on the mineral-requirements of farm animals, and it is well that stock should be taken of our knowledge from time to time in an endeavour to obtain a true perspective of the progress which any advances provide. This paper is restricted to a discussion of the lime-requirements of sheep.

Both to the research worker and to those who are to-day interested in applying the results of research work many questions will occur. It may be asked, "What progress has been made during the last fifty years concerning knowledge of the functions of lime in the animal body?" The reply would be, "Not very much." Or it may be asked, "Just how much lime should a sheep receive in its food per day, per week, or over the whole year?" One must answer, "It is not known." Or, finally, it may be asked, "Will it ever be possible to state definitely the quantities which should be present in the food of the animal?" And to this the answer is, "It is doubtful if the answer will ever be known." Among those interested in the research side of nutritional problems there may be some who will disagree with these views, but evidence will be produced to show that there are grounds for the pessimistic line of thought suggested.

PROGRESS DURING THE LAST FIFTY YEARS IN KNOWLEDGE OF THE FUNCTIONS OF LIME IN THE ANIMAL.

In dealing with any nutritional problem information obtained on one species of animal is often just as applicable to an entirely different species. One is therefore justified in discussing such problems from a wide angle. Many notable contributions have been made during recent years regarding the part played by lime in the animal economy. Many of these advances have been made by the medical sciences working hand in hand with the chemist, the physiologist, the histologist, the nutritionist, and with others. Their work has shown the important status of lime as an essential element of the body. But even to-day much of the knowledge is imperfect and incomplete, even in the minds of those whose researches have qualified them to speak with authority. The remark

* Substance of a paper presented at the conference of the New Zealand Grassland Association at Christchurch, August, 1935.

of a leading medical man writing on the use of calcium as a therapeutic agent sums up rather aptly the present position of knowledge in regard to the whole question of lime in animal nutrition when he said, "The present use of calcium is, in many instances, the introduction of an agent of which the physician knows little into a body of which he knows less in entire forgetfulness of the universal rule that any agent capable of doing good is capable, if improperly used, of doing harm." And so it is in regard to the nutritional requirements of farm animals. It is known that lime is necessary for bone-formation, membrane permeability, heart-action, the coagulation of blood and milk, nerve and muscle excitability, and the maintenance of the acid-base equilibrium in the blood, but the manner in which it acts in many of these cases, just how indispensable it is, and the optimum and minimum levels are still exceedingly obscure. It is known also that, associated with certain diseases or nutritional disorders, there may be an increase or a decrease in the level of the calcium in the blood, and that cures of these complaints are associated with a return of the blood calcium to normal, but the mechanisms whereby these changes take place, in many cases, still await a solution.

MILK-FEVER IN EWES AND COWS.

One well-known example is the case of milk-fever in ewes and cows. It has been established that this is invariably accompanied by a fall of the blood calcium from a normal value of about 10 mg. per 100 c.c. of blood serum down to levels as low as 2 mg. per 100 c.c. The records of 127 cases investigated at Canterbury Agricultural College last year were as follows :—

15	milk-fever cases	7·0–8·0	mg. calcium per 100 c.c. blood serum.
16	,,	6·0–7·0	,,
31	,,	5·0–6·0	,,
35	,,	4·0–5·0	,,
22	,,	3·0–4·0	,,
8	,,	2·0–3·0	,,

Many of the animals from which these samples were collected responded to udder-inflation, while others did not recover. Mr. A. Leslie (1934) of the Veterinary Department of Canterbury Agricultural College, who carried out the veterinary side of the work, has classified these milk-fever cases into three groups :—

(1) Poorly-nourished ewes suddenly put on to a green diet and not started to form milk ;
(2) Well-fed and well-nourished ewes (apparently high producers) and forming milk ; and
(3) Poorly-nourished ewes commencing to form milk.

All types showed a subnormal blood calcium, but knowledge of the level of the calcium in the blood does not offer a clear solution of the cause of the trouble. Milk-fever has been called "the disease of theories." Numerous theories have been put forward since the time when Schmidt, believing it to be of bacterial origin, stumbled on the udder-inflation method in 1897, or at least suggested a method of treatment which by a happy accident led to the adoption of the udder-inflation method, and by its use reduced the mortality rate considerably. And although to-day these various theories have been disproved or rejected

the true etiology of the disease still awaits solution. It can be stated fairly definitely that this decrease in the calcium in the blood is due to a disfunctioning of certain of the glands of the endocrine system—*e.g.*, the parathyroid glands—but whether other glands are also concerned and just what are the mechanisms involved are not known. Determination of the blood calcium is invaluable as a diagnostic aid, but that is all that can be said for it.

Following on the discovery by Little and Wright (1925) and Dryerre and Greig (1925) in England that in milk-fever cases there was a lowering of the blood calcium there were many who suggested that this disease must be associated with, or the result of, a deficiency of lime in the diet of such animals, but an examination of practical and experimental data cannot support this claim. Cows, even on the richest of pasture, have been known to suffer from an attack of milk-fever. True these are often the heaviest milkers, but, as Annett (1931) pointed out very clearly at the meeting of the New Zealand Grassland Association in 1931, it is very difficult to believe that on intensively managed pasture they are not receiving sufficient lime in their food to satisfy their requirements if digestive and other bodily functions are normal. Further, it has been shown that cows can produce for months on a diet which is supplying only a half, or even less than a half, of the lime that is being removed daily in the milk. This is well illustrated by the work of Groenewald (1935) at Onderstepoort, who has published recently data for cows kept on an exceptionally low-lime diet for two lactation periods. Such a drain of minerals must, of course, be serious, but these and similar experiments emphasize the high powers of adaptability possessed by the animal—in periods of shortage it can draw on its reserves, in periods of plenty these can be built up again. Under these conditions of lime-imbalance milk-fever need not occur. In fact it is doubtful if it is much more frequent than when the diet is perfectly adequate, as judged by our present-day nutritional standards for stock. The same remarks must apply to milk-fever in ewes, except, perhaps, in those cases where information collected by Leslie suggests that a low plane of nutrition can be a predisposing factor in the incidence of the disease. It would appear, therefore, that it will be necessary to look elsewhere than to the lime-content of the diet for the true explanation of the cause of milk-fever in farm animals.

If further proof is required for the justification of the views expressed it is supplied by an experiment commenced nearly four years ago by the author at Cambridge University. Several ewes were placed on a diet which was particularly low in lime and were kept on this carefully controlled diet, consisting of hay and flaked maize, for two and a quarter years. They were receiving about 1·5 grammes of lime (CaO) per day (a pasture containing 0·5 per cent. of lime would have supplied to the ewes, which averaged 150 lb. live-weight, approximately 12·4 grammes per day, a 700-per-cent. increase) and yet none died with symptoms identical with those usually associated with milk-fever. Some did die, but as a result of some other causes—*e.g.*, in two cases from a pregnancy toxæmia and in another case through death of twin lambs in utero shortly before lambing. Three were able to rear their lambs. The number of ewes worked with—nine—was rather small to allow very definite

conclusions to be drawn, but on that abnormally low-lime diet one would have expected some of them to be affected by definite milk-fever symptoms if milk-fever can be the direct result of a lime-deficiency in the diet.

MAIROA DISEASE.

The experiment just mentioned was not undertaken with the sole purpose of investigating the cause of milk-fever in ewes. At that time Mairoa disease in New Zealand was considered by some to be due to a deficiency of lime in the pasture. Aston (1928) had found that the pasture in those areas where the disease occurred contained percentages of lime (CaO) as low as 0·59 per cent. On such pastures ewes averaging 130 lb. would receive 10·8 grammes of lime (CaO) per day, over six times as much as the animals used in the Cambridge experiments, so that it was felt that if a serious lime-deficiency was the cause of the trouble, which Aston credited to lack of lime, then these animals should probably suffer from it after several months on this deficient diet. That they did not do so was regarded as evidence that the cause of Mairoa disease was not due to a deficiency of lime in the pasture. Additional support for this view is provided by the fact that in Canterbury sheep are reared, and reared successfully, on pastures which show as low a lime-content as the Mairoa pastures.

In a discussion of the possibility of a deficiency of lime being present in the ration of sheep fed entirely, or almost entirely, on grass the following information may be of interest. The two classes of sheep which will require the greatest quantity of lime in their food will be the milking-ewe and the young growing lamb or hogget. Woodman (1933) says that ewes suckling lambs give 2¼ gallons to 3½ gallons of milk per week. The latter figure may be too high for certain breeds, but if it is taken as the maximum yield it is interesting to compare the lime output in this with the ewe's lime intake from her food. During this time of the year the ewes will be consuming grass, and here in Canterbury a reasonable estimate of the lime-content should be an average of, say, November–March. At Canterbury Agricultural College this has been found to equal 0·72 per cent.

DATA FOR A EWE WEIGHING 120 LB. LIVE-WEIGHT.

Milk-yield per Week.	Lime in Milk per Week.	Food consumed per Week.	Lime in Food.
3½ gallons ..	0·077 lb.=4·99 grammes per day	27 lb.	0·194 lb.= 12·6 grammes per day.

Even when due allowance is made for functions of lime, other than milk requirements, and a low degree of utilization it is difficult to reconcile such figures with any theory postulating a shortage of lime in the diet—and this is at a period of the year when the ewe would be expected to require maximum amounts.

Furthermore, a young lamb which has been reared under good conditions will be 70 lb. to 80 lb. live-weight at four months when it is weaned, say, in December or January. By the following January it

would probably have increased its weight under Canterbury conditions to about 100 lb. to 120 lb., an increase of about 20 lb. to 50 lb. Slaughter trials have shown that a sheep (fasted live-weight) will contain in its body from 1·18 per cent. to 1·32 per cent. of lime according to its condition. Consequently the maximum storage of lime should not exceed 0·66 lb. during approximately twelve months, or an average of 0·0018 lb. (0·82 grammes) per day. Again it is difficult to believe that there could be in our New Zealand pastures insufficient lime to satisfy the above demands, under even the most diversified conditions.

In regard to various bone diseases considerable progress has been made. The etiology of rickets, osteomalacia, osteoporosis, and allied disorders have been investigated fairly completely. In view of the fact that they are associated with defective mineralization in the body they may be mentioned, but it is scarcely within the province of this paper to deal with them in any detail.

Vitamin D should, perhaps, also be mentioned since it plays such an important part in the metabolism of calcium in the body. The chemical nature of this substance has been successfully elucidated during recent years, but the exact way in which its influence is exerted in the animal-body is not yet fully understood.

Sufficient has been said, however, to show that in regard to the first question raised earlier in the paper—namely, "What progress has been made during the last fifty years concerning knowledge of the functions of lime in the body?"—many difficult points await solution.

Much progress has been made; much more requires to be made.

What are the Daily Lime-requirements in the Feed of a Sheep?

The question includes the words "in the feed." A fairly accurate estimate can be made, of course, of the approximate amounts of lime required to be stored by the animal at various stages of growth. Using data which Henry and Morrison (1928) quote from slaughter experiments the following table of lime storage could be constructed to represent maximum storage rates for lime:—

Weight. lb.	Lime (CaO) stored in Body. lb. (approximately).
10	0·132
50	0·660
100	1·320
150	1·980

and then in the case of pregnant ewes further additions could be made for the developing lamb. This would be found to increase with the age of the fœtal lamb. Bass (1923) gives the following figures as the absorption of calcium by the fœtus in the human being:—

0·0048 gramme	daily up to the	120th day of pregnancy.
0·083	,,	120th to 150th day of pregnancy.
0·087	,,	150th to 180th ,,
0·084	,,	180th to 210th ,,
0·638	,,	210th to 270th ,,

A somewhat similar relationship should hold for ewes, the fœtal demand for lime increasing as bone-formation became fairly rapid during the latter months of the gestation period.

And finally the quantity of lime in the milk can be calculated with a fair degree of accuracy. Sufficient work has been carried out to give an approximate idea of how much milk is secreted by a ewe while suckling her lamb. The percentage of lime in this remains fairly uniform under the most diverse conditions, so that the average daily or weekly output in the milk can be calculated. Pröscher (1914) found that ewe's milk contains 0·271 per cent. lime (CaO), Abderhalden (1914), 0·245 per cent. Shearer and Stewart (1931), in a comparison of the milk of ewes on poor hill pasture in Northumberland with that of a similar flock receiving a mineral supplement, obtained 0·215 per cent. and 0·224 per cent. respectively. The lime-deficient ewes at Cambridge yielded milk varying from 0·200 per cent. to 0·299 per cent. of lime (CaO).

All this data will give the total quantities of lime which must be removed from the diet of the animal (excluding that excreted in the urine—a very small amount; and that excreted through the large intestine into the fæces and voided with it—a varying amount which may be quite large at times) but is no index of the amount which must be present in the food. It would be necessary to know the digestibility or availability of the lime in the food in order to determine this. It would probably be possible to find this out with a reasonable degree of accuracy if rations were absolutely standardized, if the percentage of fibre was always the same, if the lignification had proceeded to the same degree, if mineral ratios did not vary, and so on. Such, however, is not the case in practice and can never hope to be so that it is not necessary to follow such a train of thought further.

One does not have to work for any length of time on mineral-metabolism studies in order to find vastly different storage rates under a level of food intake which remains fairly constant. It is evident that there must be a multiplicity of factors which will account for this. This is amply borne out by the following storage rates of some of the animals experimented with at Cambridge :—

LIME BALANCES DURING FOURTEEN-DAY PERIODS.

Period.	Wether.	Food Intake.	Stored.
		Grammes.	Grammes.
1	1	25·38	−5·05
2	..	25·57	−2·52
3	..	24·80	+0·17
1	2	23·86	−9·10
2	..	25·10	−3·85
3	..	24·96	−2·07
6	1	6·34	−3·35
7	2	7·07	−0·47
9	..	7·31	−7·23

It is sometimes possible to explain differences such as those shown by the two animals in the above table, but more frequently a correct

interpretation of the data is not possible. The large fluctuations in the fortnightly balances with the above animals were undoubtedly due partly to the fact that they were on an abnormally low diet.

In some experiments that were carried out at Canterbury Agricultural College last year with mature wethers, which were receiving a much larger food intake of lime, these discrepancies were still observed.

LIME BALANCES DURING TWELVE-DAY PERIODS.

Period.	Wether.	Food Intake.	Stored.
		Grammes.	Grammes.
1	23	129·8	+15·5
	348	127·4	+ 4·9
	468	148·5	+22·8
	48	148·5	+16·1
2	23	145·2	− 2·5
	348	114·8	− 4·8
	468	162·4	− 2·8
	48	168·0	+ 3·0

WILL IT EVER BE POSSIBLE TO STATE DEFINITELY THE QUANTITIES WHICH SHOULD BE PRESENT IN THE FOOD OF THE ANIMAL?

Such factors as the availability of the minerals in different types of feed, the effect of alteration of the mineral ratios, variations in the vitamin D content of the food, and other factors influencing absorption in the alimentary canal, the change in the requirement of the animal at different times of the year, and variations which are the result of certain idiosyncracies peculiar to individual animals must preclude the hope that our knowledge of the subject can ever be a very exact one.

It is necessary only to consider the data given by different authorities for the requirement of farm animals in order to realize their inability to agree on definite standards. Take, for example, the milking-cow. Based on Kellner's standard—namely, 32·5 grammes calcium per 1,000 lb. live-weight and 0·87 grammes calcium per pound of milk—the requirements per gallon of milk are:—

Maintenance, plus	1 gallon	..	41·2 grammes calcium.
,, ,,	2 gallons	..	49·9 ,,
,, ,,	3 ,,	..	58·6 ,,
,, ,,	4 ,,	..	67·3 ,,
,, ,,	5 ,,	..	76·0 ,,

These figures of Kellner imply a utilization of 62 per cent. of the food calcium for milk-formation. Crichton (1930), however, says that on an ordinary ration an assimilation of 15 per cent. to 20 per cent.

of the mineral matter may be expected. Assuming that only 20 per cent. of the food calcium is assimilated, then the requirements for a 1,000 lb. cow would be :—

Maintenance, plus 1 gallon	..	59·4 grammes calcium.
,, ,, 2 gallons	..	86·3 ,,
,, ,, 3 ,,	..	113·2 ,,
,, ,, 4 ,,	..	140·1 ,,
,, ,, 5 ,,	..	167·0 ,,

Kellner's figures are considerably lower than those given by Crichton, which emphasizes the uncertainty of our knowledge of the mineral requirements for such a well-known substance as lime, and in view of the wide range in the quality of the grass, hay, silage, and various supplementary crops other than grass such differences as those in the above table will always be encountered.

Another factor which must be remembered in any attempt to draw up definite dietary standards is the remarkable degree of adaptability possessed by animals. The experimental sheep used at Cambridge showed this to a marked degree. Young growing wethers placed on the same low-lime diet as the ewes which have already been mentioned were subjected to metabolism studies. Although their food intake was well below the usually accepted dietary standards they soon adjusted their lime balances and even managed to store a small amount. A further reduction in the lime in the food-supply once more threw the animals on to a negative lime balance, but this was again adjusted by the animals to a positive one. This will be clear from the data in the following table :—

LIME BALANCES.

Period.	Daily Food-supply.	Mean Daily Balance.	Period.	Daily Food-supply.	Mean Daily Balance.
	Lamb No. 1.			*Lamb No. 2.*	
	Grammes.	Grammes.		Grammes.	Grammes.
1 ..	1·81	−0·36	1 ..	1·70	−0·65
2 ..	1·82	−0·18	2 ..	1·79	−0·27
3 ..	1·77	+0·01	3 ..	1·78	−0·15
4 ..	1·29	−0·03	4 ..	1·10	−0·21
5 ..	1·05	+0·09	5 ..	1·30	+0·05
6 ..	0·45	−0·24	6 ..	0·34	−0·35
	Lamb No. 3.			*Lamb No. 4.*	
	Grammes.	Grammes.		Grammes.	Grammes.
1 ..	0·71	−0·24	1 ..	1·21	−0·24
2 ..	0·67	−0·14	2 ..	1·15	−0·25
3 ..	0·97	−0·18	3 ..	1·27	−0·08
4 ..	0·77	+0·12	4 ..	1·17	+0·04

NOTE.—Each period lasted for fourteen days.

It should be obvious, therefore, that it is difficult, if not impossible, to make any statement regarding definite requirements for farm animals.

The Approximate Assessment of Lime-requirements.

If the above statements and assumptions are correct, the question naturally arises "What standards should be adopted for farm animals?"

It has been made adequately clear that this will not be a fixed amount—milking ewes will require more than dry sheep, young growing lambs more than mature ones, and so on. In practice possibly the safest recommendation that could be made would be to calculate the amount stored in the body, or utilized in milk-formation, &c., and assume a 30-per-cent. to 60-per-cent. utilization of the lime in the food and then calculate the quantity which would require to be present in the food to satisfy this demand. The percentage utilization (30 per cent. to 60 per cent.) will depend upon such factors as (1) nature of foodstuff—*e.g.*, young grass is much more digestible than more mature material; (2) nature for which required—*e.g.*, the data obtained by various research workers suggests that lactating animals utilize the minerals in their food more efficiently than non-lactating animals.

Despite the large volume of information which is available on the lime-requirement of farm animals the mass of experimental material which has been collected by the different Research Institutions, and a certain amount of theorizing on the subject, it is not possible yet to draw up a definite set of feed-requirements for sheep under various dietary conditions. The view has been taken in this paper that this will not be possible, and reasons for this have been given.

Under those conditions where supplementary feeding is practised fairly extensively the shortage of lime in certain feeds may, of course, become serious and the addition of lime supplements may not only be advisable, but may even be necessary if success is to be achieved. The remarks in this paper, however, are written more from a grassland point of view for those localities where the major portion of the animals' requirements are derived throughout the year from grass. The subject of supplementary feeding would increase the scope of this paper too much, and it is not proposed to deal with it here.

Cases of rickets have been known to occur among sheep brought from poor country on to better pastures, or sometimes among stud sheep which are being reared on a high plane of nutrition. The observations made in this paper might suggest that this trouble should not occur under conditions where the animals are placed on pasture which has a moderately high lime-content. In the case of sheep, however, brought from hard country on to better-quality pastures the sudden stimulation to extra growth may induce an unbalanced set of conditions in which mineralization does not keep pace with the other growth processes taking place in the body, and rickets may result. In the case of the other example—namely, stud sheep which are living on a high plane of nutrition—a somewhat similar state of affairs exists. These are, perhaps, special cases where the use of a mineral supplement may be necessary.

The somewhat pessimistic line of thought adopted has been prompted by many frequently asking if mineral supplements should be fed to

sheep. Often the sheep are doing well without them, the lambing percentages are good, and very little trouble of any kind is being experienced with the flock.

The view has been taken in this paper that the mineral side of animal nutrition has been overemphasized in certain cases. The feed-intake may be insufficient to satisfy the demands of the animal at certain stages in its life—for example, the poorer types of pasture during the height of lactation—but the drain of lime from the bone reserves at this time can, under average conditions, be built up again during the non-lactating and non-pregnant period. In this paper an endeavour has been made to present a truer perspective of the position in regard to certain aspects of the lime-requirements of sheep. It has, of course, been possible to deal with only a few of the major points which discussion of such a subject should suggest.

REFERENCES.

ABDERHALDEN and PRÖSCHER (1914): Quoted by Forbes and Keith (1914). Ohio Agric. Expt. Stat. Tech. Bull. No. 5, 159.
ANNETT (1931): Rept. First Confer., N.Z. Grassland Association.
ASTON (1928): *N.Z. Jour. of Agric.*, *37*, 145.
BASS (1923): Quoted by Widdows (1923). Biochem. Journal, *17*, 34.
CRICHTON (1930): *J. Dairy Res.*, *2*, 1.
DRYERRE and GREIG (1925): *Vet. Rec.*, *5*, 225.
GROENEWALD (1935): Onderstepoort Jnl., *4*, 93.
HENRY and MORRISON (1928): "Feeds and Feeding."
LESLIE (1934): Half-yearly Rept., Canterbury Agric. College., Sept.
LITTLE and WRIGHT (1925): *Brit. J. Exp. Path.*, *6*, 129.
SHEARER and STEWART (1931): Univ. Camb. Instit. Animal Path., 2nd Report, *121*.
WOODMAN (1933): "Rations for Live-stock." Bull. 48, Ministry of Agriculture and Fisheries.

SWEDE AND TURNIP VARIETIES.

THEIR DESCRIPTION AND DISTRIBUTION IN NEW ZEALAND.

J. W. HADFIELD and R. A. CALDER, Agronomy Section, Plant Research Station, Palmerston North.

(Concluded.)

YELLOW FLESHED-GREEN TOP (NETTED).

Varieties: Romney Marsh, Centenary.

Foliage green with slight tinge of purple. Mid-rib and stalk green, but in a few cases purple at base. Crown rounded. Shoulders rounded. Root globe-shaped, with a tendency to taper. Skin colour above ground-level, green; below, yellow. Skin-texture netted. Flesh yellow and moderately firm.

For all practical purposes these varieties may be regarded as synonymous, the bulk of the seed being sold as Romney Marsh. They are by no means extensively grown and are not regarded as being as hardy as the Aberdeens.

TABLE 3.—THE DISTRIBUTION OF YELLOW-FLESHED TURNIP VARIETIES IN NEW ZEALAND STATED AS THE ACREAGE IN EACH DISTRICT AND AS A PERCENTAGE OF THE AREA IN YELLOW-FLESHED TURNIPS IN EACH DISTRICT, WITH A SUMMARY FOR ALL NEW ZEALAND.

Area devoted to	East and West Southland, Mid and South Otago.	Central and North Otago, South Canterbury.	Mid and North Canterbury.*	Marlborough and Nelson.	Manawatu and Wanganui.	South and North Taranaki.	Wairarapa, Hawke's Bay, and Poverty Bay.	Waikato, King-country, and Central Plateau.	North and South Auckland, Bay of Plenty.	All New Zealand.
All varieties—Acreage ..	47,000	10,450	7,450	700	1,700	2,200	500	1,650	1,500	73,550
Purple Top Yellow Aberdeen—										
Percentage	35·5	37·1	25·03	35·7	37·9	19·9	55·4	45·3	57·8	34·9
Acreage	16,830	3,883	1,665	250	645	437	278	747·5	868	25,603·5
Waites Eclipse—										
Percentage	13·2	3·8	†	2·1	†	..	..	..	..	9·4
Acreage	6,399	400	52·5	15	15	..	..	..	..	6,881·5
Bruce—										
Percentage	8·1	†	†	..	..	..	†	..	..	5·4
Acreage	3,849	36	112·5	..	..	..	3	..	..	4,000·5
Green Top Yellow Aberdeen—										
Percentage	25·2	33·7	30·3	55·0	37·0	24·6	27·0	44·7	38·9	28·2
Acreage	11,940	3,528	2,257	385	645	542	135	737·5	594	20,764·0
Fosterton Hybrid—										
Percentage	2·8	8·7	20·3	3·0	†	..	..	..	†	5·2
Acreage	1,357·5	913	1,512·5	21	15	..	..	..	6	3,825
Dales Hybrid—										
Percentage	2·1	3·1	3·1	..	..	..	..	..	..	2·1
Acreage	984	328·5	235	..	..	..	..	..	..	1,547·5
Wallace—										
Percentage	†	..	..	..	..	..	..	..	..	0·6
Acreage	436·5	..	..	..	..	..	..	..	..	436·5
Romney Marsh—										
Percentage	3·4	2·4	†	..	†	37·7	3·0	†	†	4·0
Acreage	1,656	251·5	112·5	..	20	831	15	31	12	2,929·0
Centenary—										
Percentage	†	..	†	..	..	8·5	14·0	..	†	1·1
Acreage	436·5	..	112·5	..	..	188·5	70	..	20	827·5
Yellow Tankard—										
Percentage	..	..	..	..	..	2·8	..	..	..	0·08
Acreage	..	..	..	..	..	57·5	..	..	..	57·5

* Of Mid-Canterbury acreage 10 per cent. is Webb's Renown.

† Under 2 per cent. of the area of the district.

YELLOW FLESHED-YELLOW TOP GROUP.

Variety: Yellow Tankard.

Foliage green, mottled with red; mid-rib and stalks green, occasionally tinged with reddish-purple at base. Crown rounded. Shoulders rounded. Root tankard-shaped. Skin colour above and below ground-level a pale yellow or deep cream; texture smooth. Flesh yellow, moderately firm, no discoloration.

The group is of little commercial importance.

In Table 3 the distribution of the more important varieties is given in tabular form as a percentage of the area in yellow-fleshed turnips in each district, with a summary for all New Zealand. The figures are, of course, approximate, more particularly in view of the fact that many growers mix varieties together before sowing.

White Fleshed Turnips.

Varieties may be grouped most conveniently as follows:—

Purple Top: Purple Top Mammoth.
Green Top: Imperial Green Globe, Hardy Green Globe.
Red Top; Red Paragon, Lincolnshire Red Globe.
White Top: Early Six Weeks, Whitestone Stubble, Pomeranian White Globe.
Mottled Top: Devonshire Greystone.

White-fleshed turnips occupy an area approximately three times that of yellow-fleshed turnips. They are most extensively grown in Canterbury, where the acreage of 83,000 is more than half that devoted to white-fleshed turnips in the Dominion.

The main characteristics desired in white-fleshed turnips are early maturity and keeping-quality. As the earliest varieties are the poorest keepers it is frequently necessary to sacrifice one character for the other or to grow varieties of different maturity so that they will be available as required. Hence the difference between one group and another is chiefly a matter of maturity and keeping-qualities.

The White Top group may be regarded as the earliest (Fig. 11). They are virtually not grown in New Zealand. Purple Top Mammoth (Fig. 8*b*) is the standard early variety and occupies about 11 per cent., or 17,000 acres, of the total 159,000 acres of white-fleshed turnips grown. Devonshire Greystone (Fig. 8*a*) is of about the same maturity as Purple Top Mammoth, but is not popular, occupying only about 2·6 per cent. of the acreage.

Red Paragon and Lincolnshire Red Globe (Fig. 10) may be regarded as synonyms, and follow close behind Purple Top Mammoth, occupying about 13 per cent. of the total. They are slightly later than Purple Top Mammoth.

Hardy Green Globe and Imperial Green Globe (Fig. 9) are the latest varieties and by far the most important. They may for all practical purposes be regarded as synonyms, and together occupy nearly 70 per cent., or 109,200 acres, of the total 159,000 acres. They combine better than any other the desired characteristics of excellent keeping-quality and reasonably early maturity for they are in comparison with yellow-fleshed varieties extremely quick growers.

WHITE FLESHED-PURPLE TOP GROUP.

Variety : Purple Top Mammoth. (Fig. 8*b*).

Foliage green, splotched with purple ; stalks and mid-rib purple. Crown flat to round. Shoulders rounded. Root globe-shaped. Skin above ground dark purple, due to an association of red with green ; green colour may be observed generally as an uneven band at ground-level, but if not apparent here can be discerned in the underlying tissue if a

FIG. 8.

a Devonshire Greystone ; *b* Purple Top Mammoth.

thin layer of outer skin be scraped away. Lower portion of bulb white, but may be tinged with red. Skin-texture smooth. Flesh white. Maturity early.

A small percentage may be found which are red in colour with no green band and no underlying green colour, and are therefore not purples, but reds.

WHITE FLESHED-GREEN TOP GROUP.

Varieties : Imperial Green Globe (Fig. 9*a*), Hardy Green Globe (Fig. 9*b*).

Foliage green, stalk and mid-rib green, though base of stalk and leaf scars may be tinged occasionally with purple. Crown rounded.

Shoulders rounded. Root globe-shaped ; there is a tendency for Hardy Green Globe to show greater variation in shape than Imperial Green Globe and to consist of a larger proportion of oval-shaped bulbs. Skin green above ground, white below ; texture smooth. Flesh white. Maturity later than the other varieties of white fleshed turnips recorded.

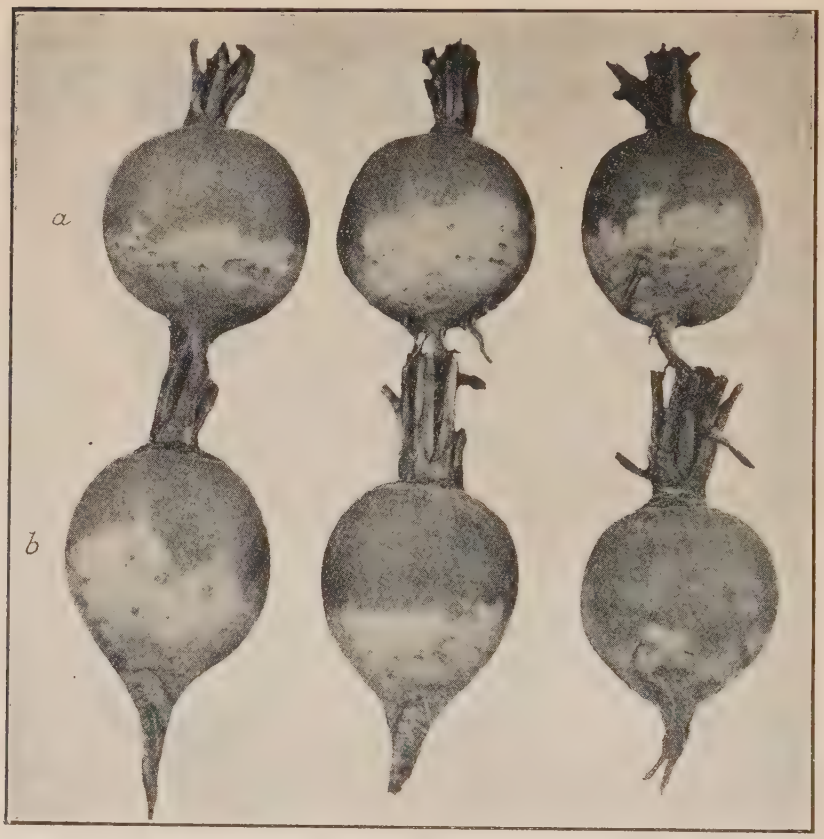


FIG. 9.

a Imperial Green Globe ; *b* Hardy Green Globe.

WHITE FLESHED-RED TOP GROUP.

Varieties : Lincolnshire Red Globe (Fig. 10*b*), Red Paragon (Fig. 10*a*).

Foliage green with a red mottling, which becomes more evident towards maturity ; stalks and mid-rib red. Crown flat to round. Shoulders rounded to square. Root globe-shaped ; Lincolnshire Red is slightly more oval than Red Paragon. Skin above ground bright red in colour without the underlying green of Purple Top Mammoth ; below ground white, occasionally tinged with red ; texture smooth. Flesh white. Maturity, second early.

Occasional Purple Tops, with or without green band, but always with green underlying, are to be found and are not true reds.

WHITE FLESHED - WHITE (CREAM) TOP GROUP.

Varieties : Early Six Weeks (Fig. 11*b*), Whitestone Stubble (Fig. 11*a*), Pomeranian White Globe (Fig. 11*c*).

Foliage green ; mid-rib and stalks green, but frequently tinged with a reddish-purple colour at base. In early Six Weeks and Whitestone

FIG. 10.

a Red Paragon ; *b* Lincolnshire Red Globe.

Stubble the crown is flat or sunken, but in Pomeranian White Globe it is rounded. Shoulders rounded to square in Early Six Weeks and Whitestone Stubble ; rounded in Pomeranian White Globe. Root, Early Six Weeks and Whitestone Stubble are flat, whereas Pomeranian White Globe is globe-shaped ; whole surface creamy-white in colour and very smooth in texture. Flesh white. Maturity, first early.

WHITE FLESHED-GREYSTONE GROUP.

Variety : Devonshire Greystone (Fig. 8*a*).

Foliage green with some red mottling ; mid-rib and stalks variegated red and green, chiefly red. Crown flat to round. Shoulders rounded to square. Root globe-shaped. Skin colour varies, presenting the following types : 1, green tops ; 2, purple tops, with or without the green band ; and 3, variegated or mottled tops. This is the dominant type within which occur variation from green-mottled with horizontal strips

FIG. 11.

a Whitestone Stubble ; *b* Early Six Weeks ; *c* Pomeranian White Globe.

of reddish-purple to purples or reddish-purples through which green shows on horizontal strips ; colour below ground-level is white. Skin-texture smooth. Flesh white. Maturity, early.

The distribution of varieties is shown in the following table (Table 4) as a percentage of the area in white-fleshed turnips in each district and summary for New Zealand. No attempt has been made to differentiate between Hardy and Imperial Green Globe nor between Red Paragon and Lincolnshire Red Globe.

TABLE 4.—THE DISTRIBUTION OF WHITE-FLESHED TURNIP VARIETIES IN NEW ZEALAND STATED AS THE ACREAGE IN EACH DISTRICT AND AS A PERCENTAGE OF THE AREA IN WHITE-FLESHED TURNIPS IN EACH DISTRICT, WITH A SUMMARY FOR ALL NEW ZEALAND.

Area devoted to	East and West Southland, Mid and South Otago.	Central and North Otago, South Canterbury.	Mid and North Canterbury.	Marlborough and Nelson.	Manawatu and Wanganui.	South and North Taranaki.	Wairarapa, Hawke's Bay, and Poverty Bay.	Waikato, King-country, and Central Plateau.	North and South Auckland, Bay of Plenty.	All New Zealand.
All varieties—Acreage ..	22,800	28,950	63,400	5,300	18,300	5,360	6,200	1,750	7,350	159,410
Purple Top Mammoth—										
Percentage	13·3	5·0	5·8	12·3	21·6	13·8	14·4	38·1	30·7	11·6
Acreage	3,042	1,447	3,654	655	4,068	735	895	666	2,260	18,422
Hardy Green Globe, Imperial Green Globe—										
Percentage	59·1	80·7	67·4	71·5	71·2	75·9	66·1	52·5	48·7	68·4
Acreage	13,295	23,390	42,790	3,790	13,045	4,077	4,100	919	3,582	108,989
Red Paragon, Lincolnshire Red Globe—										
Percentage	16·6	13·9	17·5	3·0	*	9·7	13·5	3·7	6·2	13·2
Acreage	3,800	4,040	11,100	160	81	518	835	65	462	21,061
Early Six Weeks—										
Percentage	*	..	*	..	..	..	..	*	..	0·64
Acreage	37	..	951	..	..	..	..	31	..	1,020
Devonshire Greystone—										
Percentage	7·9	*	*	5·6	..	*	2·4	..	11·9	2·62
Acreage	1,816	73	951	300	..	30	153	..	877	4,198

* Under 2 per cent. of the area of the district.

Review.

Turnips and swedes are grown extensively in New Zealand for forage purposes, but the distribution and utilization of the different types are determined by their distinct specific characteristics.

Soft or white fleshed turnips contain about 8 per cent. of dry matter and have the poorest feeding-value. They are therefore the lowest fertility-demanders and can be grown on relatively poor soils, where their success depends more particularly on the periodicity of the rainfall; on better land they may be expected to produce comparatively heavier yields. Their great adaptability is responsible for their wide distribution (Table 1). They are the earliest to mature but are the poorest keepers, and are generally fed to stock in the late autumn and early winter.

The yellow-fleshed turnips form an intermediate group between the soft turnips and swedes. They contain about 10 per cent. of dry matter and are, in consequence, of greater nutritive value than the white-fleshed varieties; they are later in maturing than soft turnips, their keeping-quality is satisfactory, and they are fed to stock during the late autumn and early winter. The conditions, however, under which these yellow-fleshed varieties thrive limit their distribution; they can be grown most successfully in a damp, rather cool climate, and are therefore more popular in Southland and Otago than in the North Island (Table 1).

Swedes contain about 12 per cent. of dry matter and are superior in nutritive value to turnips. They are rather high fertility-demanders and require fertile condition and copious rainfall for favourable development; thus they are grown chiefly in the western districts of the North Island and the southern parts of the South Island. Again, their susceptibility to insect-attack and to such diseases as club-root and dry-rot tend to restrict their production where these are prevalent. The growing of swedes in certain parts of Canterbury is, during most seasons, rendered almost impossible because of the association of dry weather conditions and severe aphis infestation. Swedes take longer to mature than either the white or the yellow fleshed turnips, are of excellent keeping-quality, and may be fed to stock during the winter or early spring; storage increases their feeding-value.

"Roots," as a winter forage crop, provide an excellent succulent ingredient to the animal's diet. Such material, provided it is fed with discretion, is of value in that it is comparable to summer grass, and, due to its laxative effect and palatability, exercises a favourable influence on the health and productivity of both herds and flocks.

Since the inauguration of certification in the 1929–30 season, well over half a million bushels of perennial rye-grass seed has been sealed and tagged as certified seed. In the 1932–33 and 1933–34 seasons almost one-third of the total perennial rye-grass seed production was certified, while it is probable that a certain proportion of the uncertified seed can be traced back to a certified origin. The ear-marking of this quantity of seed has given purchasers an opportunity of selecting high-quality seed in a market where previous to the introduction of certification good, medium, and poor strains were sold more or less indiscriminately.—*Director of Fields Division, Annual Report.*

LEMON-CULTURE.

W. K. DALLAS, Citriculturist.

(Continued.)

PLANTING-OPERATIONS.

For heavy or moderately heavy soils that are liable to remain cold and sodden during the winter months spring planting is preferable to autumn planting, since the soil is in better condition after lying fallow during the winter. Further, as the trees are set out in soil which is becoming warmer, the roots soon establish themselves. Autumn planting is suited to most well-drained soils provided the land is well worked prior to planting.

The trees should be planted on the square system, as this facilitates cultivation. Trees to be set out on better-class land should be planted from 25 ft. to 30 ft. apart. The former requires sixty-nine trees per acre and the latter forty-eight trees per acre. It is not advisable to plant trees closer than 25 ft., as a less distance does not allow for the land between the trees to be effectively worked or cover-crops grown when the trees reach full stature.

For the purposes of economical working, as well as general appearance, it is important that the trees be planted in lines, so that from whatever point they are viewed the rows look perfectly straight. Full details in connection with the laying-out of an orchard is given in Bulletin No. 84 (New Series) entitled, "Orchard Establishment and the Establishment of Young Fruit-trees."

PLANTING.

The sites for the trees having been marked with pegs, the holes should be dug and the soil removed and scattered broadcast. Before planting it is advisable to mix lime, superphosphate, and bone-dust together—three of lime, two of superphosphate, and one of bone-dust—and to place six handfuls of the mixture into each hole and work it well into the soil. If not attended to when heeled-in the roots of the young trees should be examined and damaged parts cut off.

In the process of transplanting there is always some loss of roots. The tops should be lightened to balance this loss, as it is difficult to re-establish a tree with a head heavy in proportion to the roots. This may be effected by removing superfluous branches—three to four main branches being sufficient to make the foundation of a tree—or by shortening growths as the case may require, or by both removing and shortening shoots. In the case of pot-grown trees it is necessary to disentangle the roots, and unless the soil can be removed easily the ball should be immersed in water and all the soil washed away. The roots can then be spread out in a proper manner. When a young tree is furnished with spreading roots it is well to make a mound in the centre of the hole, on which to place the tree with the roots pointing down the sides of the mound. The soil for filling in is obtained by digging the surrounding soil forward. The advantage of this method is threefold: it breaks down the walls of the hole, does away with a possible pot-hole for water, and ensures that nothing but top soil will

come in contact with the roots. If the soil is of a heavy nature the filling-in should be done with a digging-fork. It is advisable to tread the soil firmly over the roots but to leave the surface soil loose. During the planting-operations the roots should not be left exposed to the summer wind or allowed to become dry. To neglect this precaution may cause a loss of trees.

Pruning.

In the study of the methods adopted for the pruning of lemon-trees it is found that a great many trees are not pruned sufficiently. While over-pruning is not recommended, the pruning should be sufficient to maintain a fairly open-headed tree furnished with a good supply of thrifty fruiting laterals. Except for the winter and early spring months, pruning may be carried out at any season of the year. The most suitable period, particularly if heavy cutting has to be resorted to, is in the spring at the commencement of tree-growth, when the wound-gum is present in sufficient quantity to protect the tissues against the entrance of disease through the wounds.

The pruning of the tree should begin with the one-year rod from the bud. The height at which the one-year tree should be cut will depend upon the height that it is desired to make the head. For convenience in working the orchard the tendency now is to prune the rod back to a height of about 3 ft. from the ground. It is, however, advisable to cut a little higher for the following reasons: Firstly, it is impossible to be sure of keeping the top shoot. Top shoots are frequently strong in growth, and until well on in the season their hold on the main stem is not too secure. In windy places they are liable to be blown off, which may be disastrous to the development of a well-balanced tree if other suitable branches are not available. Secondly, some trees send up the first shoots too near to the perpendicular. If the young tree is headed a little higher than the top branch is required the upper shoots crowd the lower ones out, and so the desired angle to form a broad base to the trees is obtained. Further, there are other branches to select from in case any are blown off.

During the first year after the heading-back of the rod the shoots which develop should not be touched as the tree needs as much foliage as possible with which to develop a good root-system, strong branches, and to protect the trunk from the sun.

In the second year the branches to form the framework should be selected. Each tree should have from three to four main branches, the distance between the lowest and highest being from 10 in. to 12 in. The lowest branch should be at least 2 ft. from the ground. The branches should be arranged spirally on the trunk and not opposite each other, because when leaders are in whorls they are liable under stress to break away from the trunk. Those branches which are not required should be removed carefully.

Young trees received from the nursery in most instances are branched trees two years from the bud with the head already formed. When the young trees are planted shoots not required should be removed in order to restore the balance between the top and the root. Normally the selected branches do not need shortening, but where they have made very strong growth it may be desirable to head them back.

The trunks should be protected from sun-scald either by white-washing or by wrapping newspaper or other suitable material around them.

During the first three years after planting very little pruning is necessary—merely sufficient to keep the trees upright, to develop a shapely open, balanced head, and to remove superfluous shoots. Branches which are growing strongly to the detriment of others may require heading-in to increase the strength of weaker branches and to induce lateral growth. The trees should have as many leaders as will fully furnish the tree without crowding.

There are a number of methods adopted by growers to develop the framework of the trees. One method which gives a tree of the desired symmetrical form and openness of head is to select three or four leaders, which should be inclined at about a 45° angle. This should be done at the end of the second or the third year after planting, when the trees are well established and strong growth has been made. Of the vertical growths which arise from the leaders two strong well-spaced vertical shoots should be selected. Other vertical shoots should be either kept in subjection or removed, and the leader shortened back to the outside selected vertical growth. Two years later, when the selected shoots have made strong growth, each should be cut back to two suitably placed strong lateral shoots, thus doubling the number of leaders. From the vertical shoots which arise from these laterals one shoot on each should be chosen, and two years later, when these selected shoots have made strong growth, each should be shortened back to a strong lateral-growth. The treatment of the past two years should be repeated until the trees reach a height of 10 ft. In most situations the trees should not be allowed to exceed 10 ft. to 12 ft. in height, as such a height allows of much of the fruit being gathered from the ground and of pruning and spraying being more readily carried out. This system of training provides shapely trees, each having from twelve to sixteen leaders which should carry heavy crops without undue bending. The centre of the trees should not be allowed to become filled with vigorous shoots.

Young lemon trees should receive attention two or three times a year for the purpose of cutting back branches that are outgrowing the remainder of the tree and to remove suckers, especially should they arise from the trunks of the young trees.

To maintain a maximum supply of fruiting wood the stronger subsidiary lateral growths should be pinched back to cause them to send out fruiting wood nearer to their base and close to the main branches. Trees with an open centre carry fruit both on the inside as well as on the outside of the trees. The lower growth should be kept well above the ground-level and all straggling shoots and branches cut back to preserve as nearly as possible an even contour in the whole tree. All brush (unthrifty lateral growth), water-shoots, and dead and dying wood appearing in the tree should be pruned out entirely. If the wood is young and vigorous the fruit will develop better, and much of it will mature in the summer. Growth that has been injured by frost should be cut back to sound tissue. A fairly open head in the tree fosters fruiting laterals and facilitates effective spraying. When a tree is allowed to grow with little or no attention it may produce a fair crop for a time, but much of the fruit will be on the ends of branches

where it is liable to sway with the wind and become rubbed and bruised. Branches may be also broken by the weight of fruit, thus reducing the productiveness of the tree. To keep the mature tree shapely and fruitful it is desirable that it should receive attention once a year. Neglected trees are difficult to spray and often become infected with fungous diseases and infested with insect pests to an otherwise avoidable degree.

Sharp secateurs to enable smooth cuts to be made are essential as are also a sharp saw, and a knife to smooth off the tissues ruptured by the use of the saw. A protective wound-covering should be applied to all wounds over half an inch in diameter.

Cultivation.

The depth to which the soil may be cultivated is governed by type of soil and depth of rooting of the trees. As there is a tendency for young lemon-trees to develop roots near the surface the ploughing during the first few years should be relatively deep near the trees. The space around the trees not reached by the plough should be hand-dug, and any roots met with near the surface severed close to the trunk by a clean cut. As the trees increase in size the ploughing should be restricted to the area outside the spread of the trees, and the ground beneath the trees can then only be surface-cultivated. When this stage of the tree development is reached the trees will have a well-established root system in the middle and lower strata of soil. The importance of a good depth of well-cultivated soil cannot be too strongly emphasized, because unless this is provided the roots cannot long remain sufficiently active to produce continuously heavy crops of fruit suitable for commercial purposes.

The amount and character of cultivation, however, given to an orchard must be governed to a large extent by the nature of the soil and the climate. Usually it is best to plough to a depth of from 6 in. to 8 in. in the autumn and cross-plough in the spring. During the summer months the surface should be kept loose with a cultivator, ploughing at that time being inadvisable, as it tends to dry the soil.

In the autumn the first furrows may be turned up against or towards the trees and an open furrow left in the middle of each "land" between the trees. In the spring the order is reversed, and thus the soil is brought back to its original position. The spring ploughing should be done as early as practicable, either in August or early September, and should cover all weeds and trash lying on the ground. The soil should then be worked down to a fine tilth, which should be maintained throughout the summer. The ground under the trees should be dug over to a depth of from 5 in. to 6 in. at least three times a year. In working soil where the main mass of feeding roots have been allowed to become established close to the surface the depth of cultivation should not be so deep as to cause a serious loss of roots.

The effect of cultivation upon the soil organisms (bacteria, fungi, and protozoa) is often overlooked. It is to these countless silent workers that a rich soil mainly owes its fertility. Thorough aeration,

obtained only by cultivation, is necessary for the micro-organisms to thrive and carry on their important work of soil improvement.

Cover Crops.

For the successful growing of lemons it is essential to have a soil with a high humus-content. Besides assisting with the elaboration of plant-foods, especially nitrogen, organic matter increases the capacity of the soil to retain moisture and improves the aeration of the soil. The humus-content should be built up by green manuring before planting the orchard, and while the trees are young and deep ploughing is possible. To maintain the trees in thrifty condition after they have come into bearing cover-cropping should be continued.

Legumes are most suitable for cover crops, since they grow rapidly and are rich in nitrogenous matter. Those recommended are horse-beans, lupins, vetches, and field peas used either alone or in combination with oats, barley, &c. A mixture of equal quantities of superphosphate and carbonate of lime often may be broadcasted profitably with cover crops at the rate of 6 cwt. per acre.

In some districts weed-growth may be sufficient to maintain an adequate humus-content of the soil. During the early summer weeds, on account of their demand upon soil-moisture, should be suppressed, but when early autumn rains are experienced they may be allowed to grow. Where the herbage of weeds is allowed to grow it would be good practice to augment it with a legume broadcast early in February to come up in advance of the weeds.

Before ploughing a green crop under it is good practice to cut it into pieces with the disks, as this ensures a more even distribution of the organic matter. A green crop should not be ploughed in while the soil is in a dry state, unless it be in the late autumn with winter rains soon to follow. A fair amount of soil-moisture is necessary to ensure the decay, and when moisture is in scant supply the crop decays very slowly. Green manuring should not be carried out during the later part of the spring or summer, since the bulk of the material may remain undecomposed thus keeping the soil open with a consequent loss of valuable moisture.

It is recognized that a green crop ploughed into the soil may have at first a temporary impoverishing effect, reducing for a time the available nitrogen. It is therefore necessary that green crops should be turned in at a time when the trees are requiring a minimum amount of nitrogen, this being about midwinter. Soil-moisture is usually abundant at this time, and decomposition should be well advanced before the trees reach full activity.

For the first four or five years vegetable crops may be grown between the rows of trees. It usually is advisable to manure for these crops, and they should not be planted so close to the trees as to interfere with the young roots. If these matters are attended to intercropping is beneficial, as the cultivation necessary for the crops improves the condition of the soil. Potatoes, kumaras, tomatoes, peas, beans, and other leguminous crops are suitable.

Fertilizers.

To obtain profitable crops and maintain satisfactory growth citrus trees require ample supplies of plant-foods. Although the turning-in of cover crops and frequent cultivation do much to enrich the soil the addition of artificial manures is also necessary. Manuring, however, should not be overdone. Experiments have shown that nitrogen and, to a less extent, phosphates and potash increase yield and improve the quality and hardiness of the new growth. Best results are obtained with fertilizers where there is an ample supply of decaying organic matter and moisture in the soil.

Nitrogen encourages growth. Fertilizers which contain nitrogen are sulphate of ammonia (20 per cent. nitrogen), nitrate of soda (15·5 per cent. nitrogen), blood and bone (4 per cent. to 8 per cent. nitrogen), dried blood (10 per cent. to 12 per cent. nitrogen), bone-dust (3 per cent. nitrogen), and farmyard, sheep, and fowl manure. Nitrate of soda should not be used regularly upon clay soils. Blood and bone, which also contains phosphate, is used extensively by citrus growers. It takes usually at least four times as much blood and bone as sulphate of ammonia to supply a given quantity of nitrogen. Sulphate of ammonia is generally the cheapest per unit of nitrogen, but as its regular use increases soil acidity an annual application of 1½ lb. carbonate of lime for each 1 lb. sulphate of ammonia is necessary, applied about one month prior to the spring application of nitrogen.

Phosphates promote root-growth, better setting of fruit, and earlier maturity of crops. Phosphates are normally supplied as superphosphates, basic phosphates, basic slag, blood and bone, and as bone dust, but the particular form used depends on local conditions and cost.

Potash is stated to improve flavour and the colour and smoothness of the skin. It is abundant in the majority of New Zealand soils, and in most localities only small dressings are necessary. Wood ashes that have not been weakened by rain are also a source of potash as well as of phosphates and should not be wasted. Where plenty of such ashes are available no other potash will be needed; about 500 lb. per acre is an adequate dressing.

Other manures which may be used are blood and bone, well-matured fish manure, and meat-meal. Lime improves the physical condition of heavy soils, and is also useful in correcting soil acidity.

Recommendations for Applications of Manures.

If possible, organic matter, such as cover crops, farmyard, sheep, fowl, and well-conditioned fish manure, &c., should be turned in annually.

The fertilizers recommended for young non-bearing trees, distributed over the area occupied by the roots, are—For the first year after planting sulphate of ammonia and superphosphate, ½ lb. each, and sulphate of potash, ¼ lb. per tree, followed by an annual increase of ½ lb. of the two former and ¼ lb. of the latter per tree until the trees come into bearing. In addition, carbonate of lime should be applied at the rate of 1½ lb. for every 1 lb. of sulphate of ammonia used.

The quantities given in the following table are to be used as a basis for manuring bearing trees from four years to twelve years from planting.

Annual Dressing of Fertilizers for Bearing Trees from Four Years to Twelve Years from Planting.

Fertilizer.	Period of Application.		
	Spring (August-September).	Early Autumn (April).	Late Summer (January-February).
Sulphate of ammonia	2 lb. to 5 lb. per tree..	2 to 5 lb. per tree	..
Lime (carbonate) ..	1½ lb. to each 1 lb. of sulphate of ammonia applied. Apply at least one month prior to dressing of sulphate of ammonia and work into soil	..	3 cwt. per acre combined with superphosphate mentioned below.
	(Above treatments to be applied within spread of trees.)		
Superphosphate ..	3 lb. per tree, applied within spread of tree prior to deepest working	..	3 cwt. per acre broadcast at time of sowing cover crop.
Potash (sulphate) ..	1½ lb. per tree combined with phosphate	..	..

Nitrate of soda may be substituted for sulphate of ammonia if desired. For older trees the dressings, in most situations, should be increased.

Diseases and Insect Pests.

Fungous diseases and insect pests are more readily controlled when the trees are given good care. A tree crowded with growth provides a suitable harbour for pests and renders treatment very difficult. Important factors in the control of diseases and insect pests are proper attention to drainage, improvement of the soil, pruning, and the maintenance of clean surroundings, including the gathering and the destroying of decaying fruit before the spores are ready for dissemination. A bulletin dealing with the treatment of diseases and pests of citrus in New Zealand is in the course of preparation.

Renovating Old and Unthrifty Trees.

Trees may become unthrifty from a variety of causes, such as a heavy infestation of insect pests or the presence of fungous diseases, want of systematic pruning, bearing continuously heavy crops of fruit, or old age. So long as the roots and trunk are sound it is possible to restore trees of poor production to a thrifty condition. Such trees may have a good deal of dead wood, may have run up in a straggling manner, or have lost branches through breaking down. These trees should be treated by cutting back the broken, dead, and diseased branches to healthy tissue and removing superfluous growth. The heading-back of the main branches should be done in the early part of October and should not be too severe the first year, but only partially done so as to avoid removing too much foliage before new growth develops.

The tree during the spring and early summer should be then sprayed two to three times with a summer oil at a 2½-per-cent. dilution. In the winter following the appearance of the new shoots upon the lower parts of the tree the renovating may be continued. The hard cutting of the tree back to the main leaders should be done about July. Branches removed should be cut back to the branch or trunk from which they issue, so as to leave no "snags." Large wounds should be painted over either with Colas (a bitumen product), Stockholm tar, or a thick mixture of white-lead and oil. The trunks and limbs exposed to the sun by pruning should be protected from sunscald by applying a coat of white-wash. The soil around these trees should be cultivated deeply towards the end of April, before the late autumn or winter rains set in. The cultivation should become deeper with increasing distance from the trunk. Any available well-rotted manure or orchard and garden refuse should be worked into the soil around the trees. Should a good rain not be experienced within a fortnight the subsoiled trees should be given a good watering. The trees will soon push out numbers of new shoots. These should be thinned to the number required to furnish the tree with new branches and be afterwards subjected to the same shortening as described in a previous paragraph under the heading of pruning. Trees that are dying because of roots lost from disease or from unsuitable soil conditions obviously cannot be resuscitated, and should be destroyed.

Top-working Trees.*

Trees that are in a healthy condition can be reworked with other varieties, either by budding or grafting. Usually the former method is adopted, as grafting of citrus trees is somewhat uncertain. The buds should be worked into young wood, which is obtained by heading back the trees to a suitable point on the main limbs at the beginning of October. The new growth should be thinned out during the summer, leaving sufficient selected shoots which, when worked, will refurnish the trees with new branches. If the wood has attained sufficient size the buds may be inserted during the following March; if not, the budding will have to be deferred until the following November.

In the former case the buds remain dormant till spring. When growth starts the branches should be headed down to within 8 in. of the buds. It is not advisable to head close to the buds, as the sap in the wood left above affords nourishment to them and serves as a support to which the resultant shoots may be tied to prevent them from being blown off. The stump above the bud should not be allowed to make any growth and should be cut off as soon as the shoots are strong enough to support themselves. Shoots arising from the limbs and any remaining branches should not be removed immediately, but kept in subjection by thinning and heading back for two seasons, until the branches arising from the bud-wood are well established. If grafting is decided on, the trees should be headed back about midwinter, leaving about 1 ft. length to be cut from each limb or branch when the scions are put on. The "crown graft" method is best. It should be carried out between mid-August and mid-September. The exposed tissues should be carefully covered with petrolatum jelly or grafting-wax.

* If further information in reference to budding and grafting is desired it may be obtained from the following departmental bulletins: Bulletin No. 81, "The Budding of Fruit-trees"; Bulletin No. 98, "The Grafting of Fruit-trees."

Picking, Curing, and Marketing.

The care and skill required for picking, curing, and marketing lemons is as great as that needed in establishing and maintaining the orchard itself, and the results obtained at the harvesting stage necessarily mean success or failure of the whole venture. That lemons can be grown successfully in the warmer parts of the Dominion has been amply demonstrated, but this is not in itself sufficient to ensure the establishment of a successful lemon industry. There is demanded in addition a much more complete knowledge and practice of the art of curing than at present obtains in New Zealand to enable the grower to carry his fruit with a minimum of loss over such periods as the exigencies of the market may demand.

(To be continued.)

SEED CERTIFICATION.

SUMMARY OF OPERATIONS FOR SEASON, 1934–35.

J. H. Claridge, Certification Officer, Fields Division, Wellington.

The following summary covers the activities of the Fields Division of the Department of Agriculture in relation to seed certification in the 1934–35 season, the eighth season of operation.

Extensions in the scheme during the season have been made to cover the certification of Italian rye-grass seed, while an additional class of perennial rye-grass seed has been formed, in which the qualification for certification is a satisfactory report upon examination by means of ultra-violet light.

The returns show an increase of 11 per cent. in the number of entries made in the season just completed, increases being shown in respect to all seeds except perennial rye-grass, turnip, and swede seeds, relative to which appreciable decreases are recorded.

Perennial Rye-grass.

An additional class, "Certified Commercial Seed," was introduced during the 1934–35 season. While the seed of this class is not subject to such rigorous testing as is the seed certified under other classes, the test applied, nevertheless, is of such a nature that the "certified commercial" seed includes only those lines of definitely perennial habits. In very many cases seed certified in this class would under a different system of testing qualify in the "Permanent Pasture" or even the "Mother" class of seed. The procedure used is, briefly, to seal temporarily and sample lines of machine-dressed seed in store and submit the sample for test by ultra-violet light. Upon the result of this test the sacks are either sealed as certified seed, or else unsealed and left as ordinary uncertified seed. Despite the fact that the scheme was not introduced until March of this year, the amount of seed certified to the end of September totalled 41,500 bushels.

In the "Mother" and "Permanent Pasture" classes a further reduction in acreage inspected (from 13,236 acres to 11,351 acres) is recorded. However, because of an increase in average yield of

2½ bushels per acre, the amount of seed finally sealed and tagged has increased by 21,000 bushels, to give a return of 141,000 bushels. The grand total of perennial rye-grass seed certified during 1934–35 amounts to 182,500 bushels, an increase of 52 per cent. over the 1933–34 returns.

The germination of all lines this season has been entirely satisfactory, while only in a few instances has any difficulty been met in attaining the necessary standards of purity.

Cocksfoot.

Cocksfoot seed certification has proceeded along the usual channels during the 1934–35 season. With a 45-per-cent. increase in the acreage entered, coupled with an average yield of more than double that recorded for 1933–34, the total produce sealed and tagged amounts to 716,000 lb., compared with 200,000 lb. for the previous season. The proportion of seed certified on the Akaroa Peninsula, under the immediate supervision of the Akaroa Cocksfoot Seed Growers' Association, has fallen considerably, despite the fact that the total produce from this district shows a considerable increase. The greatest increase in production was in the Mid-Canterbury district, where the acreage entered was doubled, while average yields rose from 36 lb. to 220 lb. per acre.

Practically all the seed was certified in the "Mother" class, less than a ton of seed being classed "Permanent Pasture," this being because it was harvested from young areas.

White Clover.

The amount of white-clover seed certified during the 1934–35 season was 93,000 lb., as compared with 20,000 lb. during the 1933–34 season. Increases have been recorded in all three classes. The "Mother" and "Permanent Pasture" classes each show an increase in production of over 100 per cent. The greatest increase, however, is shown in the "First Harvest" class, where the production has increased from a little over a ton to 22 tons. All seed in this class is "once-grown" from Mother seed, so that the benefits of the change of basis of certification from one of age of pasture to one of type of clover, made in the 1931–32 season, are now becoming evident.

A further 8,700 lb. of field-dressed seed harvested from certain areas in the North Canterbury district, and considered to be of a reasonably good type, has been held under official supervision pending the receipt of a sample trial report. This amount is slightly less than the quantity similarly held in 1933–34.

Brown-top.

The growers of brown-top have added their share to the increase recorded in the amount of seed certified during 1934–35. With the number of areas entered increasing from 103 to 215, and the amount of seed sealed and tagged increasing from 119,000 lb. to 384,500 lb., the reason for the fall in price of this seed during the season is not hard to find. While Otago has again produced the most seed of any one district, Southland has shown the greatest increase in production. Mid-Canterbury and South Canterbury districts have between them produced 98,000 lb. of seed, almost three times the amount produced in these districts in the previous season.

RED CLOVER.

The acreage of Montgomery red clover entered for certification in 1934–35 is more than double that for the previous season. One and a half tons of Mother seed and 12 tons of Permanent Pasture seed have been sealed and tagged, as against a total of $7\frac{1}{2}$ tons during the season 1933–34. The demand for this seed appears to be good, and reports indicate that farmers are now more appreciative of its worth.

ITALIAN RYE-GRASS.

The certification of Italian rye-grass seed was undertaken this season for the first time. The type aimed at is one which will produce a high bulk of leafage in its first season, and at the same time will come away for further feeding after cutting. Twenty-one areas had been sown down with seed once grown from imported lines of known good type, and these formed the basis for the scheme. Fourteen areas passed the necessary standard at field inspection, and the produce of these, amounting to over 5,500 bushels, was sealed and tagged as certified seed.

WHEAT.

Despite a decline in the acreage of wheat entered for the 1934–35 season, the actual acreage passed (1,334 acres) is over 200 acres more than that passed in the previous season. The quantity of seed sealed after machine-dressing has increased from 6,000 bushels to 11,000 bushels. It is interesting to note that over 2,000 bushels of the new variety—Cross 7—has been placed on the market after being finally tagged and sealed.

POTATOES.

A further increase of 84 crops has brought the number of crops inspected during the 1934–35 season to 513. The percentage of crops passed has increased from 76 per cent. to 87 per cent., in spite of the fact that a higher standard in regard to freedom from virus diseases has been insisted on.

The division of crops into "Mother" and "Commercial" and the regulation disallowing the re-entry into certification of those areas where Commercial seed had been planted, has given the grower a great degree of security in regard to the acceptance of his crop when re-entered for certification, as is shown in the following figures.

Crops inspected in 1934–35.	Total Number.	Number rejected.	Percentage rejected.
Areas planted with Mother seed ..	377	10	2·7
Areas planted with Commercial seed ..	79	38	48·1

In most cases the amount of virus in rejected crops is lower than what may be expected in an average uncertified crop, and, in fact, the rejected crops in the main would have been certified in former years. This serves to indicate the raising of the standard in regard to certified potatoes, even though a higher percentage of crops is being passed.

Table giving Quantities of each Seed certified and Estimate of the Total Value of Seed certified in each Season.

Seed.	Chief consideration upon which Certification is based.		Quantities of Seed finally certified.							
			1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.
Potatoes ..	Varietal purity, cropping-power, and freedom from virus disease	Tons	217	249	511	760	818	938	1,806	1,821
Wheat ..	Varietal purity and freedom from loose and stinking smuts	Bush.	3,840	11,682	16,714	4,060*	1,283*	7,001	6,012	11,110
White clover	Age of pasture, 1928–31; type of clover, 1931–35	Lb.	..	10,595	69,015	67,242	6,131*	33,731	20,337	93,381
Perennial rye-grass	Genuine perennial type	Bush.	..	..	17,052	45,982	81,186	245,667	119,019	182,386
Brown-top	Freedom from red-top (*Agrostis palustris*)	Lb.	..	..	170,071	171,083	198,343	138,843	118,978	384,588
Cocksfoot ..	Type as exemplified in the produce of Akaroa Peninsula	,,	..	..	..	..	171,720	622,765	200,560	715,982
Red clover	Type conforming to that of English-grown Montgomery red clover	,,	..	..	..	..	1,550	3,763	17,263	30,558
Brassicas ..	Varietal purity and freedom from disease	,,	..	..	..	..	..	..	22,515	522
Italian rye-grass	A rapid-growing, high-producing type, showing recovery after cutting	Bush.	..	..	..	..	..	..	..	5,121
Estimated value of seeds finally certified			£2,070	£4,889	£30,328	£40,048	£57,358	£142,585	£79,018	£154,725

* Reductions accounted for by changes in regulations.

Total estimated value of seed certified (1927–35), £511,021.

The number of entries in the qualification trials has increased slightly. The condition of the samples received indicates that there are still a large number of crops being grown from seed which is infected badly with virus and far from pure. This seed could, without exception, be replaced with certified seed, with profit to the grower.

Brassica Crops.

The amount of turnip-seed certified this season was very restricted, while no swede crop was entered. Two nucleus areas of rape-seed of specified type have been grown under certification.

General.

The accompanying table records the quantities of seed of each crop finally certified since the inauguration of seed certification in 1927. By fixing a basic value for each seed an attempt has been made also to show the total value of all seeds certified from season to season. It should be remembered in connection with this table that seed sold in a field-dressed condition, and, in regard to potatoes, seed sold as provisionally certified, has not been included.

Persons or firms interested in the complete tabulated results may obtain copies of these on application to the Director, Fields Division, Department of Agriculture, Wellington.

CORTICIUM-DISEASE OF POTATOES.

THE EFFECT OF CROP ROTATION ON ITS PERSISTENCE IN THE SOIL.

E. E. Chamberlain, Mycological Laboratory, Plant Research Station, Palmerston North.

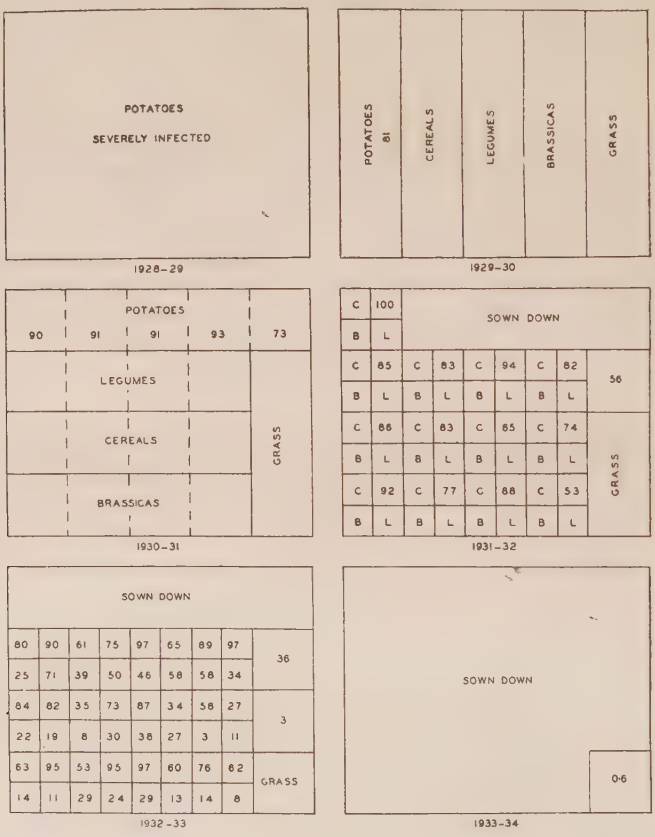
Corticium-disease, caused by *Corticium vagum* Berk. et Curt., is one of the commonest and most widely distributed diseases of potatoes. Because of its prevalence it has received much attention in both this and other countries. Under New Zealand conditions its symptoms, economic importance, and control have already been discussed (Cunningham, 1925; Cunningham and Neill, 1926; Chamberlain, 1931, 1932, (*a*) and (*b*). The disease attacks a wide range of plants and is both tuber and soil borne. No advantage is to be gained by planting clean tubers in infected soil and many workers* have suggested crop rotation as a means of eliminating soil infection. In order to obtain information with reference to the effect of various crops on the persistence of corticium a crop-rotation experiment was laid down. The nature of the rotations planned may be seen from the accompanying figure. Three years' results of a portion of this experiment have already been published (Chamberlain, 1931), but are being recorded again in the present article.

Details of the experiment are as follows:—

1928–29.—The whole area, which was 2½ chains long by 2 chains wide, was planted with corticium-infected potatoes. An inspection of the crop was made during harvest and a high percentage of the tubers found to be infected.

* References to literature dealing with host range, soil persistence, and the effect of crop rotation on corticium are given in a previous article (Chamberlain, 1931).

1929–30.—The area was divided into five blocks each 2 chains long by $\frac{1}{2}$ chain wide and sown as indicated in the figure. Since no corticium-free potatoes were available the potato block was planted with infected tubers which had been treated by the acidulated corrosive sublimate method.* During harvesting counts were taken and 81 per cent. of corticium infection was recorded. A control plot of 120 tubers from the same line of treated seed, planted in soil which had not previously grown potatoes, showed 8 per cent. infection at digging.



PLAN OF $\frac{1}{2}$ ACRE PLOT SHOWING CROPS GROWN DURING EACH OF SIX SUCCESSIVE YEARS.

The figures represent in each case, the percentage of corticium infection.

The letters C, B, and L used on the plan for the 1931–32 season indicate that cereals, brassicas, and legumes respectively were grown on the lettered plots.

The areas in the 1931–32, 1932–33, and 1933–34 seasons marked "sown down" represent portions of the plot withdrawn from the experiment.

1930–31.—Sowings were made as indicated in the figure. The potatoes planted were seed tubers hand-selected for freedom from corticium infection and then treated by the acidulated corrosive sublimate method. The percentage of infected plants which each plot showed at harvesting is given in the figure. A control plot of ninety

* This treatment is as follows: The potatoes are soaked for one hour and a half in a solution of 1 part corrosive sublimate, 6·6 parts concentrated hydrochloric acid, and 1,000 parts water.

plants from the selected treated seed, grown in soil where there had not been a previous crop of potatoes, showed complete freedom from the disease.

From a consideration of the results it appears that one year in cereals, brassicas, or legumes had no effect on the incidence of corticium infection, but that grass did appear to reduce slightly the amount of infection.

1931–32.—The greater portion of the area was divided up into blocks $\frac{1}{4}$ chain square and sown with various crops as shown in the figure. Again the potatoes planted were hand-picked, treated seed. The figures given represent the percentage of corticium infection in each potato plot.

It would appear that a two-year rotation with cereals, brassicas, or legumes brought about a slight reduction in corticium infection, though this reduction was not so great as that produced by two years in grass.

1932–33.—Except for one section withdrawn from the experiment and one grass plot $\frac{1}{2}$ chain square, the whole area was planted with hand-picked treated potato tubers. The influence of the various crop rotations is shown by the percentage infections given in the plan.

From these results it would appear that cereals are slightly less effective than brassicas or legumes in reducing corticium infection, and that three years in grass considerably reduces the amount of disease.

1933–34.—The remaining grass plot was planted with corticium-free potatoes. Only 160 tubers were planted, and of the resulting plants one developed corticium.

Apparently the bulk of the soil-infection had disappeared from this plot, which had been four years in grass.

Summary.

(1) Crop rotations of two or three years with cereals, brassicas, and legumes tended to reduce the amount of corticium infection in the soil.

(2) Cereals appeared to be slightly less effective than brassicas or legumes in reducing soil-infection.

(3) Grass gave a greater and more consistent reduction in the amount of corticium infection than did any of the above-mentioned crops.

(4) Four years in grass practically eliminated the disease from the soil.

Literature cited.

Chamberlain, E. E. (1931): *N.Z. Journ. of Agric.*, Vol. 43, pp. 204–209.
——— (1932): (*a*) *N.Z. Journ. of Agric.*, Vol. 44, pp. 42–47.
——— (1932): (*b*) *N.Z. Journ. of Agric.*, Vol. 44, pp. 122–126.
Cunningham, G. H. (1925): *N.Z. Journ. of Agric.*, Vol. 30, pp. 14–21 and 93–96.
Cunningham, G. H., and Neill, J. C. (1926): *N.Z. Journ. of Agric.*, Vol. 33, pp. 174–175.

The Fields Division Officer at Blenheim reports that subterranean clover at Ben Morven has spread well up the hillsides and over otherwise bare clay faces. The sward is excellent and the sheep relish the clover.

SOME ASPECTS OF THE SMALL-SEED INDUSTRY IN OTAGO AND SOUTHLAND.*

WITH PARTICULAR REFERENCE TO RYE-GRASS SEED AND THE ESTABLISHMENT OF A PERMANENT EXPORT TRADE.

J. O. WALLACE, Fields Division, Department of Agriculture, Dunedin.

THE production of small agricultural seeds, particularly rye-grass, is no new industry in Otago and Southland, which rank in the forefront among provinces in respect to the production of these seeds.

Rye-grass for seed-production was grown quite extensively as far back as 1870, and then evidently it was considered an important industry, for in the papers of Sir Julius Vogel, printed in 1875, and relative to Otago, the commercial price of rye-grass seed is shown as from 3s. 6d. to 6s. a bushel. It can be taken for granted that to command attention in such a paper the rye-grass seed crop must have been of some moment.

The production of fescue and of brown-top seed in such quantities as to include them in the export category originated much later—fescue in the early years of the current century and brown-top later still, actually in 1921.

About 1870 a growing demand for southern oats arose, the demand developing not only in New Zealand, but also in Australia and Tasmania, and in 1883 southern districts harvested 157,000 acres for grain. The present acreage harvested is approximately 37,000 acres. The demand for oats, which were required principally for horse-feed, grew out of the extensive programme of private and public works embracing road and rail construction. After the oat crop it appeared to be the general practice to follow with a short lea, the sowing being English grasses with rye-grass dominant in the mixture, and it was invariably the practice to take a seed-crop the first or second year. In the absence of definite data a good measure of the quantity of grass-seed harvested at the period can be obtained from the acreage of oats harvested, bearing in mind that all the land had to be resown to grass. Liming of the soil was not practised to any extent at this period, and as Yorkshire fog and sorrel became troublesome, constituting impurities that were difficult to remove by manually operated riddles, minds of the commercial men engaged in the industry were, by virtue of necessity, turned towards the possibility of power-operated seed-cleaning machines, and the period 1880–85 saw the first commercial power-operated seed-dressing plants established in the South. Much of the seed which went into commerce in the early days of the industry was lacking in the state of purity which we find to-day, and "bushel-weight" was the paramount factor in the buying and selling of grass-seed.

Following on from this period and in an endeavour to show the trend or stability of small-seed production in southern districts recourse has been made to the agricultural statistics, and a number of years taken at random. Figures for Canterbury, also an important seed-producing area, are given for comparison, also those for Hawke's Bay and Gisborne districts grouped together for a similar purpose.

* Substance of a paper presented at the Conference of the New Zealand Grassland Association at Christchurch, August, 1935.

In the year 1898–99 the areas, in acres, harvested for seed-production were—

	Rye-grass.	Other Grass and Clover Seeds.
Southern districts	23,252	3,798
Canterbury	24,749	26,277
Hawke's Bay and Gisborne ..	7,046	4,054

"Other," relative to southern districts, while not definitely stated, no doubt refers to timothy and dogstail. Southland at this time enjoyed a fair trade in timothy to the North Island.

In the year 1904–5 the areas, in acres, harvested for seed-production were—

	Rye-grass.	Other Grass and Clover Seeds.
Southland	15,985	1,638
Canterbury	7,074	35,791
Hawke's Bay and Gisborne ..	7,598	2,852

For the year 1911–12 a return was prepared from data collected during October and November, a time most opportune for the collection of reliable data. For this particular year the areas, in acres, harvested for seed-production were—

	Rye-grass.	Other Grass and Clover Seeds.
Southland	39,831	4,482
Canterbury	19,071	28,053
Hawke's Bay and Gisborne ..	4,626	1,376

In the year 1921–22 the areas, in acres, harvested for seed-production were—

	Rye-grass.	Other Grass and Clover Seeds.
Southern districts	23,107	13,792
Canterbury	23,097	20,917
Hawke's Bay and Gisborne ..	2,241	67

In this year the area utilized in the Wellington Province for the production of small seeds was almost equivalent to the area used for the same purpose in Hawke's Bay and Gisborne Districts.

In the year 1930–31 the corresponding areas were—

	Rye-grass.	Other Grass and Clover Seeds.
Southern districts	18,997	18,525
Canterbury	22,036	18,711
Hawke's Bay and Gisborne ..	5,066	523

In the Wellington District the production of small seed declined to insignificant quantities.

In the year 1933–34 the corresponding areas were—

	Rye-grass.	Other Grass and Clover Seeds.
Southern districts	17,390	21,869
Canterbury	19,651	20,639
Hawke's Bay and Gisborne ..	5,989	768

Seed-certification commenced with the 1929–30 season. It was hoped that the organization would be instrumental in making available sufficient supplies of better strains than that widely grown

in southern districts not only to meet our own requirements, but to provide a balance for export. In the initial stages of the work the possibilities with the certified type of rye-grass in developing an external trade appeared quite good, and the development of such a trade seemed a matter only of producing sufficient seed. Most merchants, especially the exporting houses, willingly co-operated with officials of the Department of Agriculture in giving publicity overseas to the work being done in connection with strain improvement in grass and to the virtues of the certified product.

Southern growers accepted the adverse reports directed against their local types of rye-grass, but appreciated the possibilities of a permanent export trade with the declared better regional strains of the North Island. Having gained a full knowledge of the cultural methods by long practical experience, and having available the machinery required for harvesting, &c., they embarked on the growing of the certified strains of rye-grass with some enthusiasm. In the first year merchants contracted with growers to purchase the crops at a premium, and growers were anxious to obtain seed though it was costing up to 27s. 6d. per bushel. One grower alone, specially prepared, sowed and harvested 225 acres for seed. Unfortunately it was ascertained subsequent to threshing the crops that the seed, while normal in appearance, was of very low germination and not marketable, though crops of the southern strains produced seed of normal germination. This resulted in a serious setback not only to growers of rye-grass in Southland, but to the rye-grass-certification scheme. As a result of the low germination progress has been to some extent arrested in the southern seed-producing areas, and the sowing of the certified type of rye-grass with seed-production in view is not now enthusiastically entertained.

The data given previously show that rye-grass seed-production in southern districts has been more or less constant from the "eighties," and it is of moment that yields per acre in southern districts are double those of the North Island and greater than those of Canterbury. The failure of the certified strain of rye-grass in the South has been openly discussed and some subscribe to the view that the southern district must surrender its position in the production of rye-grass seed. In this connection the question arises, Can we afford to let this happen?

That there are possibilities of building a permanent export trade in certified rye-grass seed is accepted generally in official and commercial quarters, and the following figures support this contention. For eight months, May to December, 1933, the export of perennial rye-grass from New Zealand was as follows: Certified, 2,008 cwt., value, £2,710; uncertified, 13,978 cwt., value, £16,150; other rye-grass, 18,595 cwt., value, £21,889. It is apparent that our overseas customers have purchased our uncertified seed because, no doubt, there was no certified seed available at the price offering, but a certain class of uncertified seed may become an obstacle to the building-up of a permanent trade in certified seed.

If we could produce the certified seed in sufficient quantities to have available sufficient supplies for export at a reasonable price, overseas buyers would purchase our seed not on the policy

of having to, owing to short supplies in their own countries, but on the realization that it was a superior strain. Should southern districts cease producing, would it be possible for other districts to produce sufficient to meet internal requirements, and at the same time have a sufficient balance for export at an attractive price—not 10s. to 12s. per bushel, but at 5s. to 6s. per bushel, which would be a payable and encouraging price to southern farmers? It seems, in view of the preceding considerations, that this is highly impossible. It appears obvious, therefore, that if the districts of the South relinquish rye-grass seed-production, which they may do unless the low-germination obstacle is overcome, the prospect of establishing a permanent export business of creditable dimensions is small, as influences operating in other parts of the Dominion seriously hinder the production of the required regular supplies. A rise in the price of meat and wool would, it is believed, be followed by a further decrease in seed-production in the North Island. The rise in the price of wool two years ago was followed by a substantial decrease in certified seed-production, and there appears to be a return to those farming operations allied to the staple industry of the district—*i.e.*, meat and wool production.

Eyes might turn to Canterbury, but a rise in the price of wheat might have the same effect as the rise in the price of wool in Hawke's Bay. Again, drought is to some extent against the venture, and as a result regular supplies cannot be relied upon. In any case, with southern districts eliminated it would be necessary to double Canterbury's present crop to meet internal requirements, let alone to leave a substantial balance for export.

Through the failure of the certified rye-grass to produce viable seed under ordinary conditions in southern districts, New Zealand is probably losing many thousands of pounds annually.

The matter of raising improved strains in grass is of first importance to southern farmers, and they are anxious to see a measure of the work of selecting and breeding undertaken in their own district. Their case seems to be strengthened by the fact that the difficulty of low germination was not unmasked until the selected certified strain was brought to southern districts for commercial cropping, whereas the work of selecting and determining the value of the selection was confined exclusively to the North Island.

In regard to small-seed production New Zealand has in Otago and Southland a veritable inheritance. Practically every important common species of grass and clover can be grown successfully for seed. One may point to the revenue from the export of brown-top and fescue seed, and merchants must be commended in fostering the production of these seeds and in finding overseas markets for them without national assistance.

There is still ample scope for expansion, and much of the seed now imported could be grown here. In 1933, 3,201 cwt. of timothy was imported, whereas it can be grown successfully in Southland. A fair trade in the seed of this species was enjoyed by southern growers up till 1905, but it rapidly fell away through shipping lines containing ragwort seed.

It is gratifying that some of the principal merchants are encouraging the growing for seed of some of the species now

imported almost wholly by supplying the stock seed and guaranteeing to buy the produce. Growers are pioneering the production of seed of crested wheat-grass, millet (fair amounts of which reach this country from England, though most of it is grown in Turkey), and *Phalaris tuberosa*, and to these will probably be added Indian hemp, to meet our own domestic and probable export requirements; particularly does this apply to *Phalaris tuberosa*, a good opening for which appears to exist in Australia.

Apart from figures relative to acreage, &c., the amount of small-seed production in Southland may be gauged from the fact that there are in constant operation eighteen commercial seed-dressing plants in Otago and Southland.

DAIRY-HERD TESTING IN NEW ZEALAND.

REVIEW OF THE 1934–35 SEASON.

W. M. SINGLETON, Director of the Dairy Division, Department of Agriculture, Wellington.

THE past season witnessed a definite falling-off in the number of cows submitted for test, while a climatically unfavourable dairying season resulted in a decline in average production of tested cows. Some 256,931 cows were tested, as compared with 297,647 for 1933–34, representing a decrease of 40,716 cows, or 13·67 per cent. The average butterfat-production per tested cow was 252·01 lb., a falling-off of 10·43 lb. fat over the previous season's average of 262·44 lb. While, however, there was a decrease in the number of testing dairy-herd owners, and consequently of cows, it is pleasing to note that the total number of groups was not merely maintained, but increased. A return to better butterfat prices and more normal conditions should make it possible to regain the lost ground.

Table 1 provides statistics relating to dairy cows in milk and dry, and covering the past ten years. The steady advance in New Zealand's dairy-cow population is obvious.

Table 1.—Dairy Cows in Milk and Dry as at 31st January of each Year.

Season.	Total Cows.	Cows in Milk.	Dry Cows.	Percentage of Dry Cows to Total.
1925–26	1,303,856	1,181,441	122,415	9·4
1926–27	1,303,225	1,181,545	121,680	9·3
1927–28	1,352,398	1,242,729	109,669	8·1
1928–29	1,371,063	1,291,204	79,859	5·8
1929–30	1,441,410	1,389,541	51,869	3·6
1930–31	1,601,633	1,499,532	102,101	6·4
1931–32	1,702,070	1,582,664	119,406	7·0
1932–33	1,845,972	1,723,913	122,059	6·6
1933–34	1,932,511	1,816,402	116,109	6·0
1934–35	1,952,094	1,827,962	124,132	6·4

Table 2 provides a numerical classification of tested cows according to land district, and covers the past five seasons. From this table it will be noted that all the important dairying districts show a decrease, while for the whole of New Zealand the tested cows represented 14·5 per cent. of the total cows in milk. This is the lowest percentage since the 1925–26 season, when the corresponding figure was 14·4, the highest yet recorded being 20·4 for the 1929–30 season.

Table 2.—Numbers of Cows tested Twice or more, and Percentages of Total Cows in Milk, classified according to Land Districts.

Land District.	1930–31.		1931–32.		1932–33.		1933–34.		1934–35.	
	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.
North Auckland ..	55,283	20·9	56,091	19·6	59,408	18·8	55,801	16·4	47,658	13·7
Auckland	102,534	22·6	99,806	20·6	111,517	21·1	120,982	21·3	110,107	19·0
Gisborne	10,418	25·0	9,145	20·4	10,634	19·9	12,460	21·8	12,069	20·7
Hawke's Bay ..	8,742	16·7	4,933	9·2	5,910	10·3	5,581	8·9	5,476	9·0
Taranaki	32,519	14·7	31,179	13·8	32,302	13·6	38,878	15·7	31,599	12·7
Wellington ..	35,875	16·7	30,569	13·6	34,992	14·6	38,290	15·2	38,622	15·5
North Island ..	245,371	19·7	231,723	17·6	254,763	17·8	271,992	17·8	245,531	15·9
Nelson	5,732	20·9	6,637	23·7	7,430	23·8	4,445	13·6	4,714	14·8
Marlborough ..	3,064	19·2	2,647	16·2	2,334	13·6	2,067	11·9	1,269	8·0
Westland	2,380	18·8	5,030	39·6	2,844	20·4	2,801	19·2	2,006	14·0
Canterbury ..	3,244	4·3	2,344	3·1	4,359	5·4	4,957	6·0	4,195	5·2
Otago	3,775	7·0	4,480	7·9	4,800	7·9	3,752	6·1	2,605	4·4
Southland ..	7,838	10·9	6,996	9·4	9,524	11·7	7,633	9·3	5,624	6·9
South Island ..	26,033	10·2	28,134	10·6	31,291	11·0	25,655	8·8	20,413	7·2
Dominion ..	271,404	18·0	259,857	16·4	286,054	16·6	297,647	16·4	265,944	14·5

NOTE.—"Total Cows in Milk" is at 31st January in each year.

Table 3 is a summary indicating the number and size of the various organizations. In the sense used for this tabulation an "organization" denotes an individual unit—that is to say, a Group Herd-testing Association operating ten groups would be included as ten, not one.

Table 3.—Number of Cows, Herds, and Organizations represented in Season's Summaries received. (Basis : All Cows in Milk 100 Days or over.)

	1932–33.	1933–34.	1934–35.
Group Testing.			
Number of groups	200	213	222
Number of herds	5,090	5,120	4,559
Number of cows	253,016	266,481	240,993
Average number of herds per group	25	24	20
Average number of cows per herd	50	52	53
Average number of cows per group	1,265	1,251	1,086
Association Testing.			
Number of associations	78	73	58
Number of herds	1,242	1,105	889
Number of cows	23,163	20,408	15,938
Average number of herds per association	16	15	15
Average number of cows per herd	19	18	18
Average number of cows per association	297	280	275

Table 4 is a general production summary. Figures for 5,448 herds were surveyed for the compilation of this table, of which 4,559 were tested under the Group system and the remaining 889 under the Association-own-sample test system. The corresponding figures for 1933–34 were 6,225 herds—5,120 Group and 1,105 Association. A point worthy of note is that despite the unfavourable season the average milking period for Group cows increased by three days.

Table 4.—Grand Summary of all Herd-testing Results on the Basis of all Cows in Milk 100 Days or over received for the Last Two Seasons.

	1933–34.			1934–35.		
	Number of Cows.	Days in Milk.	Butterfat-production.	Number of Cows.	Days in Milk.	Butterfat-production.
			lb.			lb.
Average for all cows	286,889	255	262·44	256,931	258	252·01
Average for all Group cows	266,481	257	264·10	240,993	260	253·65
Average for all Association cows	20,408	230	240·79	15,938	227	227·08
Highest Group average	294	282	334·25	638	270	308·55
Lowest Group average	1,022	225	194·00	856	241	194·18
Highest Association average	108	264	337·90	66	277	339·70
Lowest Association average	106	208	178·91	120	201	156·15
Highest Group herd	15	305	551·00	20	290	484·00
Lowest Group herd	24	192	88·00	10	117	80·30
Highest Association herd	4	312	435·07	6	278	448·00
Lowest Association herd	22	126	92·00	10	122	64·46
Highest Group cow	..	261	879·00	..	248	828·00
Highest Association cow	..	294	775·00	..	289	777·00
Average daily production of butterfat for all Group cows	..	..	1·03	..	..	0·98
Average daily production of butterfat for all Association cows.	..	..	1·05	..	..	1·00

Table 5 classifies average butterfat-production of tested cows according to land district.

Table 5.—Average Production, according to Land Districts, of all Cows under Herd-test for which Seasons' Summaries were obtained. (Basis : 100 Days or over.)

Land District.	1931–32.			1932–33.			1933–34.			1934–35.		
	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.
			lb.			lb.			lb.			lb.
North Auckland	54,101	253	229·56	57,771	255	245·53	54,007	250	241·11	46,037	255	243·38
Auckland	97,218	260	233·61	108,504	264	254·67	116,769	260	262·09	106,983	263	249·12
Gisborne	8,853	250	242·29	10,265	251	254·73	11,967	251	247·50	11,686	251	239·83
Hawke's Bay	4,808	253	246·71	5,595	255	263·61	5,389	253	258·75	5,300	250	247·73
Taranaki	29,960	257	256·41	31,686	265	276·19	37,790	264	286·32	30,781	267	277·88
Wellington	29,215	244	226·03	32,012	253	255·61	36,491	255	275·64	37,010	253	253·07
North Island ..	224,155	256	235·32	245,833	260	255·62	262,413	257	262·41	237,797	260	251·86
Nelson	6,447	236	250·16	7,215	239	269·27	4,322	245	272·36	4,564	251	261·61
Marlborough	2,567	239	247·67	2,151	239	249·70	1,944	228	232·63	1,204	255	264·83
Westland	4,902	232	241·59	2,816	236	260·89	2,773	241	273·17	1,997	234	270·04
Canterbury	2,155	219	226·67	4,129	223	233·38	4,449	236	255·26	3,785	216	222·35
Otago	4,319	236	252·03	4,685	238	249·02	3,568	229	264·85	2,136	241	266·40
Southland	6,896	237	261·26	9,350	235	256·32	7,420	227	264·66	5,448	237	255·91
South Island ..	27,286	234	249·63	30,346	235	255·11	24,476	234	262·76	19,134	237	253·84
Dominion	251,441	253	236·87	276,179	257	255·57	286,889	255	262·44	256,931	258	252·01

Government Subsidy.

The New Zealand Herd-testing Central Executive held three meetings during the season. The Government subsidy for the current financial year amounts to £4,000, and arrangements have been made for allocation on lines similar to those adopted in the past, excepting that the subsidy per cow for Association-own-sample testing is to be discontinued. It is anticipated, however, that the herd-testing movement may be reorganized before next season, and in this event it is probable that the present will be the final year of subsidy on a per-cow basis.

Appreciation.

We again desire to thank officers in charge of herd-testing organizations for having provided the statistics required for the compilation of this summary.

THRIPS: WITH SPECIAL REFERENCE TO "THE GREENHOUSE THRIPS."

J. Muggeridge, Entomologist, Plant Research Station, Palmerston North.

The *Thysanoptera*, or thrips as the insects of this order commonly are called, are small and inconspicuous; what they lack in size, however, is easily compensated for by their numbers, since they are very prolific and are found on a wide range of plants.

Some of the chief characters which serve to distinguish these animals are the protrusible, bladder-like organ of the foot, the cone-shaped mouth parts, and the narrow wings, which, when present, are fringed with long hairs. The wings lie horizontally when at rest, and appear as a narrow strip along the surface of the abdomen.

The life-cycle of thrips commences in the egg-stage. The eggs are laid either on the surface of the host plant, or are inserted into the tissue by means of a sharp saw-like ovipositor. Following the egg-stage there commonly are two larval stages both of which bear a strong resemblance to the adult form in general appearance. A prepupal and a pupal stage follow next, during which the animal moves but little and takes no nourishment. From the pupal form the adult insect finally emerges. The time taken in completing the life-cycle varies considerably for different species, and is also strongly influenced by temperature conditions.

The food of thrips consists of plant juices, obtained by breaking open the plant cells by means of a chafing and rubbing action on the leaf or fruit surface and sucking the liquid contents with the cone-shaped mouth. Injury to plants is caused by attack on the foliage, the floral portions, and the fruit, "thrips-injured" foliage usually presenting a characteristic silvery-grey appearance. In severe attacks the foliage becomes brown, dry, and brittle, and subsequently dies, the plant thereby receiving a severe set-back. Injury to the flowering portions of a plant may cause the blossoms to drop prematurely so that the proper setting of seed or fruit is prevented. Direct injury

to fruit gives it a brown russety appearance and reduces considerably its market value. Of recent years thrips have been proved to be carriers of mosaic diseases of plants.

Greenhouse Thrips.

The greenhouse thrips (*Heliothrips haemorrhoidalis* Bouché) (Fig. 1) is one of the commonest and one of the most universally distributed of thrips pests. It occurs in the open in tropical and semi-tropical countries, but is commonly found under glass in colder regions. The following brief description gives the easily noticeable characters by

FIG. 1. ADULT GREENHOUSE THRIPS, SHOWING NET-LIKE MARKINGS ON HEAD AND THORAX.

[*Photomicrograph.*

which it may be recognized. It is a small insect measuring approximately $\frac{1}{20}$ in. in length. Its body is covered with deep net-like markings, which are heaviest on the head and thorax; it is blackish-brown in colour, though specimens newly emerged from the pupal state appear whitish-yellow about the abdomen; the legs and antennæ are light-coloured except that the first, second, and sixth antennal segments are shaded brown; the eighth antennal segment is long, thin, and tapering.

HABITS.

Reproduction is always parthenogenetic—*i.e.*, the eggs are unfertilized. The whole of the life cycle is spent on the host plant. By means of the sharp, saw-like ovipositor the eggs are inserted into the plant tissue; the young larva on hatching commences to feed and grow, and, after passing through the typical stages already described, the adult insect emerges. Under greenhouse conditions generations follow each other

FIG. 2. COMPARING A THRIPS-INJURED LEAF (LEFT) WITH A NORMAL HEALTHY LEAF (RIGHT).

[*Photo by H. Drake.*

FIG. 3. CITRUS FRUIT SHOWING SEVERE THRIPS INJURY.

[*Photo by H. Drake.*

throughout the year. The accompanying illustrations (Figs. 2 and 3) show typical injury caused by these pests to (*a*) plant foliage and (*b*) citrus fruit. The injury to the fruit gives it a brown russety appearance, and in the case of severe attacks the skin tends to crack.

HOSTS.

Some of the host plants recorded by the writer in New Zealand are citrus, persimmon, apple, peach, tung-oil tree, rhododendron, and azaleas.

CONTROL.

One of the best natural checks to this pest is a hard dashing rain. Where it is found necessary to resort to artificial-control measures, nicotine sulphate (40 per cent.)—commercial "Black Leaf 40"—at a strength of 1 part in 800 parts of water plus 3 lb. of soap per 100 gallons of spray can be applied with safety. Because the eggs are not affected by the above spray, further applications at ten to twelve day intervals are advisable.

Under glasshouse conditions cyanide-fumigation will be found to be effective, for details regarding the use of which see this *Journal*, pp. 47–48, January, 1934.

ACKNOWLEDGMENTS.

The writer wishes to thank those officers of the Horticulture Division who forwarded thrips material to him from time to time.

RECENT AMENDMENTS TO DAIRYING REGULATIONS.

UNDER THE DAIRY INDUSTRY ACT, 1908.

A. E. MORRISON, Solicitor, Department of Agriculture, Wellington.

BY the Dairy-produce General Regulations, Amendment No. 3, which came into force on 12th September, various amendments have been made to the general regulations governing the manufacture and export of dairy-produce. In the following notes the principal changes in the law are recorded.

Hitherto no definition was provided for the term "private dairy" for the purposes of the regulations, but premises not sufficiently equipped with appliances, drainage, &c., to justify registration as a creamery or a cheese-factory were registrable as a private dairy. Since the restrictions on the transfer of supply do not apply to private dairies supplies of milk or cream for any registered private dairy could be drawn from any farm-dairy in open competition with owners of creameries and cheese-factories. The operations of a private dairy are now restricted to the supply of milk or cream produced from cows depastured on the farm-dairy so registered, the average number of which in any month does not exceed fifty.

With a view to securing improved conditions in and about farm-dairies various amendments have been made which are designed to improve the quality of the supply from such dairies. In the case of

milking-machines provision is made for the connections to the vacuum tank from the vacuum-pump releaser, &c., to be fitted with approved unions so as to permit the connections to be readily dismantled. In addition to being notified in all cases where it is intended to erect a new milking-machine, or to re-erect a used milking-machine on a farm-dairy, an officer of the Dairy Division for the district must now be notified of intention to erect or re-erect a vacuum pump or a milking-machine engine. The floor of the milking-shed, yards, and exits must be made of concrete or other material impervious to moisture. Where skim-milk is delivered from the separator to a pipe connected with a skim-milk pump the pipe must be of tinned brass and be provided with a union at the skim-milk pump so as to permit the pipe and pump to be readily taken apart and cleansed. The arrangement and design of the separator-room and engine-room on the farm-dairy where both rooms are under the same roof have been modified to permit the walled passage between the two rooms to contain openings only of such sizes as are necessary to provide for the transmission of motive power by belt where a belt passes from the engine in the engine-room to a vacuum pump or a counter-shaft in the releaser-room.

Hitherto it was illegal to add cream to milk delivered to a cheese-factory for manufacture into cheese without the previous consent in writing of the owner of the cheese-factory. This penal provision has been extended to include the addition of any skimmed or partly skimmed milk to milk intended for delivery to any manufacturing dairy.

The provisions of the principal regulations relating to the grading of milk supplied to creameries, cheese-factories, and skimming-stations, and payment for milk not actually graded, have been amended to conform with the existing practice in manufacturing dairies where milk is not being graded daily. Proper records must be kept of all milk graded, showing the grade assigned to the milk received from each supplier and the day of grading where milk is not being graded daily.

By an amendment to the regulations governing the transfer of supply the open months in the South Island will in future be July and August instead of September and October as hitherto.

With regard to the waxing of cheese, provision has been made declaring that the waxing plant must not be erected in the curing-room or the packing-room of any cheese-factory, but must be housed in a separate room. If a door is provided from the curing-room or the packing-room to the waxing-room the door must be airtight, and if the curing-room or packing-room, as the case may be, is insulated the door to the waxing-room must also be insulated with not less than 2 in. of corkboard or its equivalent. No cheese shall be waxed which has developed acidity to a marked degree or which shows excessive weakness in body or any mould growth on the rinds. No such cheese, if waxed, shall be exported to the United Kingdom.

The general prohibition against marking butter for export with words indicative of high quality such as "Choicest," "Choice," "Superfine," or "Superior" has been modified to permit such words or words of similar import to be branded on packages of butter intended for export in the form of pats if the grade assigned to such butter is that prescribed for "Finest." If on being graded the quality of the butter is not, in the opinion of the Grader, of the standard prescribed for "Finest," he shall decline to furnish particulars of the grade or to issue a Grader's certificate until the words indicative of such high quality have to his

satisfaction been removed from the packages. No butter in the form of pats of a grade lower than that of "Finest" shall be exported in packages bearing thereon or enclosed therewith or attached thereto any such words indicative of high quality.

Various amendments are made to the specifications in respect of export butter-boxes. With a view to eliminating mould growth on butter-boxes the use of rotary-cut timber for the manufacture of butter-boxes is prohibited. The timber to be used must be sawn timber, and the ends of all boxes must be planed smooth on both sides. The thickness of boards for the standard box, the sub-standard metal-bound box, and the Saranac box must be of the dimensions hitherto prescribed in dry finished thickness. The boards for the top and bottom of the sub-standard metal-bound box are increased from $10\frac{3}{4}$ in. to 11 in. in width. The top and bottom boards of the box must be nailed to the sides by at least two nails per nailing edge evenly spaced between the metal bindings on the box. The thickness of the boards for the Saranac box must be not less than $\frac{1}{4}$ in. instead of $\frac{1}{4}$ in. as hitherto. Both side edges of each top and bottom board of the box instead of one side edge only as hitherto must completely cover the side edges of the adjoining side boards. The end boards of the box must be affixed by not less than four nails instead of three as hitherto. The timber used in the manufacture of cheese-crates must be of such species as are approved by the Director of the Dairy Division.

Hitherto it was required that cheese in grading-stores be held and delivered at different temperatures, varying according to the time of delivery from the store. Provision is now made that cheese delivered into a grading-store on or after 1st August and before 31st December must be held at a temperature of not less than 47° or more than 49° if delivered from the store on or before 31st December, and at not less than 42° or more than 44° if delivered from the store after the last-mentioned date. Cheese delivered into a grading-store on or after 1st January and before 1st August must be held at a temperature of not less than 42° or more than 44° until delivered from the store.

In addition to the foregoing, other amendments, being either consequential or of a more or less minor nature, and, in consequence, self-explanatory, are included in the regulations under review.

THE ROYAL AGRICULTURAL SOCIETY OF NEW ZEALAND (INC.).

ESSAY on

"PROBLEMS of WOOL-GROWING in NEW ZEALAND."

A PRIZE OF TWENTY GUINEAS is offered by this Society for the best essay on the above subject. Entries close 31st March, 1936.

R. McCAY,
Secretary.

P.O. Box 148, Hawera.

SEASONAL NOTES.

THE FARM.

Acute Need of establishing Reserves of Feed.

DURING the two immediately preceding years, primarily because of unfavourable seasons, the crops of both hay and silage saved in the Dominion have been unusually light. This, coupled with the fact that recently cold conditions unfavourable to growth have prevailed until exceptionally late into the spring, has resulted in a particularly heavy drain on reserves of feed still on hand, and so farmers generally are facing the coming season with relatively low reserves of feed.

As a rule, the supplies of hay and silage are below the economic needs of the stock being carried. Hence it is clear that the present position calls not only for a special effort during the current summer, to make effective use of all material that becomes available from grassland for conservation as hay or silage, but also for consideration to be given to the growing of special crops fitted to improve the feed position. Some of the most valuable crops available should already be sown, and for others the work of preparation should already be well forward; but it should be kept in mind in planning the provision of feed for the coming winter and spring that at times valuable use can be made of crops sown after mid-summer. Instances of such crops are cereals or temporary pastures sown on land which already has produced a crop in the current season. Thus if stubble is worked as soon as the oat crop is removed, the land may be sown in Western Wolths or Italian rye-grass and red clover, which will provide autumn and winter feed that is especially likely to be valuable to sheep-farmers under Canterbury and similar conditions. Similarly, cereals may be sown after oats or after soft turnips. While the preparation for these crops is not now seasonable it is seasonable to give these crops consideration in planning against the development of feed-difficulties ahead.

Haymaking of Major Importance.

Despite the well-warranted increase in the popularity of ensilage during recent years haymaking continues to be the major means of conserving surplus supplies of summer growth of grassland. In the latest season for which figures are available (1933–34) the area of grassland harvested for hay in the Auckland Province was 191,000 acres, while that devoted to ensilage was 55,000; the corresponding figures for Taranaki were 53,000 acres and 26,000 acres; while the Dominion figures were 378,000 acres for hay and 92,000 acres for ensilage. It might quite well be argued that the amount of hay saved should be increased rather than reduced and that at the same time the ensilage area advantageously could be made greater than the hay area. This is a moot point which can be left for the present since it does not affect the fact that, as things stand to-day, the hay crop is much more important than the silage crop.

Rightly, during recent years much attention has been given to preserving quality and avoiding wastage of the crop in ensilage. From the above facts it is evident that at least an equal amount of attention should be given to eliminating avoidable loss of feeding-value in haymaking. That this is particularly important is shown by authoritative figures which indicate that loss of feeding-value may readily be greater in haymaking than in ensilage: in the latter it attracts attention because it is, to a substantial extent, visible, whereas in haymaking it is likely to be overlooked because it does not obtrude itself.

Basic Causes of Poor Quality in Hay.

Essentially because of the common occurrence of unfavourable weather at the most suitable stage of pasture-growth for haymaking much of the hay saved each year is of markedly inferior quality, because either of waiting until favourable weather is experienced and thereby allowing the crop to become far too mature and stemmy or of mowing at the correct stage of growth and being forced to save hay during unfavourable weather. In short, in respect to his haymaking, the farmer often finds himself on the horns of a dilemma, and it is this dilemma that constitutes the strong case for increased attention to ensilage over wide areas. Normally relief is not obtainable by late closing to be followed by late mowing of the hay crop—as a rule late closing simply results in a light crop. Late mowing to coincide with favourable weather is undesirable not merely because it necessarily results in the production of inferior stemmy hay, but also because it tends to bring about a weakening and opening-up of the pasture and to prevent the development of a really satisfactory leafy aftermath which is likely to prove valuable as a source of highly digestible nutritious feed in the latter part of the summer when such feed is needed in dairying and is apt to be in scant supply. Because of the important advantages attaching to the cutting of the hay crop at the proper stage of growth it behoves us to utilize all means of enabling this to be done and of saving the crop in good condition at the same time.

Practices which beget Quality in Hay.

There is much evidence that cocking should be more widely practised. It is doubtful whether, in the principal haymaking districts, one can depend upon saving a heavy crop of hay in good condition without cocking, and in the case of crops of average yield, after making full allowance for the extra labour involved, cocking could be adopted with advantage on occasions when it is not practised. Cocking is to be looked upon as the ideal method of obtaining hay of the best possible quality when the weather is not altogether favourable, and although economic justification cannot be found in all cases for ideal methods there always should be sound reasons for rejecting them. Cocking proves especially valuable in the saving of lucerne and of clover hay of good quality—the leaves, which are the most valuable portions of these plants, are not so likely to be lost if cocking is carried out. When left in the swath in bright sunny weather the leaves dry and shrivel and when the hay is raked they crumble and are left on the ground. It is especially important that cocks be well made—there is a vital practical difference between a well-hearted and raked hay-cock and a mere heap. The heap readily becomes sodden when exposed to rain, so that in wet weather hay is just as well in the swath as in badly made cocks; but in well-made cocks which are able to shed much of the rain it is partly secured.

If broken weather occurs just after mowing, then, within reasonable limits, the crop should not be disturbed until good weather returns—any handling that the mown material receives makes it much more subject to the detrimental influences of bad weather. If bad weather seems imminent the cocking should be hastened, for the amount of washing-out of nutritive matter by rain is much greater when the herbage is in the swath—in the cocks the herbage may cover only one-fifth of the ground it occupies in the swath and so be subject to the washing-out effect on only one-fifth the amount of water.

In the building of the stack a good deal can be done towards securing hay of good quality. The site should be well drained and it should not be shaded in a manner which will eliminate the drying-effect of winds. For the stack-bottom there should be an ample supply of material, such as posts or branches of trees, which will provide a dry base. A stack as high as

is practicable should be built, so that the roof is small in proportion to the amount of hay. Especially in unfavourable weather, long, narrow stacks are to be preferred, because they allow of more ready drying and cooling. No one working on the stack should stand for a considerable time at one place, as this causes uneven settling. When mechanical means of hoisting the material on to the top of the stack are in use in conjunction with hay-sweeps, each load should be broken up and distributed evenly so as to avoid loosely packed "pockets" between the loads, with consequent uneven settling.

The most suitable time to cut lucerne cannot always be determined by the development of flowers. Safer guidance is obtained by noting the development of basal shoots—when new shoots coming from the bases of crown of the plants are about an inch long the lucerne should be mown.

Feed-utilization.

An important and common weakness of the feeding during early summer of "wet" stock, including ewes and sows, as well as dairy cows, arises in respect to the quality of feed as distinct from the quantity. The bulk or weight of such important summer crops as green lucerne, green maize, and green millet, as well as pasture growth, is not at all a reliable measure of their nutritive value. The feeding-value of crops is governed by the nature of the dry matter—*i.e.*, the substance that would remain if all the water in the crop were removed. In its turn the nature of the dry matter varies greatly, even within a short period, and depends upon whether the crop is in a leafy condition or is allowed to become stemmy and productive of flower-heads. The dry matter of crops at a leafy stage of growth is very suitable for "wet" stock, containing a highly digestible and well-balanced supply of the substances required by such stock, whereas the dry matter of stemmy crops, broadly, is of the reverse type. These facts assist in indicating the need for methods of crop-utilization which result in leafy herbage being available to "wet" stock. Especially in respect to pastures is this matter of current moment; methods of maintaining pastures in the desirable leafy condition were discussed in last month's notes.

General Cropping-work.

The true role of special forage crops in this Dominion may be realized adequately only if it is kept in mind that the relatively expensive grains and meals used freely in many other countries may be replaced in New Zealand to a great extent by the comparatively inexpensive farm-grown, diluted concentrates provided by such crops as rape, soft turnips, mangels, &c. Actually our markedly economical production of fat lambs and of butterfat is dependent upon our cheap production of concentrates through the use of young leafy grass and suitable forage and root crops. A keynote in any programme of consistent success with arable crops must be thorough cultivation. Other important factors in success are good seeds and, as a rule, particularly in regions of good rainfall, more liberal manuring than is usually practised.

Of the crops commonly sown at this season the swede is of much importance. Successful results have been obtained widely and consistently by sowing swedes in December at the rate of 10 oz. to 16 oz. an acre. Sowing through every second coulter of an ordinary grain drill probably is most favoured, but sowing through every coulter has given good results repeatedly; and, especially in the South Island, sowing in ridges, followed by inter-tillage, has given good results consistently over many years. The question of varieties has been discussed at considerable length in the two previous issues of this *Journal*. Modern practice in districts of good rainfall is to use 2 cwt. to 3 cwt. an acre of manure of which phosphate is the chief constituent, while in districts of light rainfall, such as Canterbury, super-phosphate at the rate of about 1 cwt. an acre mixed with an equal amount

of carbonate of lime is favoured. The mixture, which should be made at least a week before using, should be left in a heap—if put into bags it tends to set hard. When the seed is to be mixed with the manure in sowing care should be taken to avoid the serious injury to the seeds which may result from bringing them in contact, even for a short period, with readily soluble manures such as superphosphate, sulphate of ammonia, and potash salts. Injury by superphosphate may be avoided by using the lime-superphosphate mixture specified above. Steps should be taken to guard against similar seed-injury to soft turnips and rape, the sowing of which often is carried out successfully at this time.

To provide green feed in summer maize and millet may be expected to give good results in the warmer districts when sown in December. As a rule they respond profitably to a dressing of superphosphate, &c., applied at the rate of 1 cwt. to 2 cwt. an acre, and, except in the case of highly fertile soils, it is likely to be also profitable to supplement the superphosphate with a nitrogenous fertilizer.

The continued popularity of chou moellier, and in some districts an increased popularity, is well justified. This popularity is due partly to the marked resistance of chou moellier to club-root, from which, however, it is not completely immune, and partly to its good feeding-value and to its ease of feeding to sheep with the minimum of waste in situations where the wet conditions would tend to beget undue waste in feeding root crops *in situ*. Chou mollier calls for high fertility such as is required for success with cabbages. If such fertility is not present naturally, it may be provided by suitable use of farm manure such as old stack-bottoms and animal excreta, together with artificial fertilizer in which superphosphate may well be prominent. Sowings in December provide winter feeding. A suitable sowing is 1½ lb. to 2 lb. an acre in drills 2 ft. to 2½ ft. apart.

Generally the best results are obtained by sowing lucerne in the latter part of November or in December. Some information was given about lucerne establishment in these notes last month, and further information is available in Bulletin 155, which is obtainable free on application to any office of the Department of Agriculture.

Inter-tillage and Thinning.

Inter-tillage of growing crops sown in rows wide enough apart to allow of it is, as a rule, highly desirable at this season. Often in December such inter-tillage should be accompanied by thinning of crops sown in October or November. Generally the thinning may be made easier by prior hoeing along the rows. The weeding associated with such early thinning usually destroys great numbers of weed-seedlings. In thinning mangels the soil should be drawn away from the seedlings rather than to them. If at thinning-time mangels are pale and seem to be faring unsatisfactorily, they are likely to respond profitably to a top-dressing of nitrate of soda or sulphate of ammonia sprinkled along the rows, at the rate of about 1 cwt. an acre in such a way that the fertilizer is not deposited on the seedlings.

Miscellaneous.

Spraying for the control of potato-blight and other kindred crop troubles may be desirable. As a rule, satisfactory results are obtained from such spraying only when it serves as a preventive instead of as a cure. Spraying may be of considerable value in checking the spread of blight which has gained a footing, but its greatest service comes from preventing the footing being obtained. If the spraying is faulty in respect either to preparation or application, the result is likely to be either ineffective control of the trouble or damage to the crop itself. Detailed information about spraying may be obtained from local officers of the Fields Division.

Much valuable work in weed-control can be carried out in mid-summer. One aspect of this is the prevention of flowering and seed development in

perennial weeds. It is to be noted that seeds capable of reproduction often have developed earlier than the appearance of the parent plants suggests. Another phase of the work is the destruction of seedlings while they are still in the tender stage, when the task is relatively easy.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Pest and Disease Control.

Frequently many growers find the coming month a difficult one in which to keep pests and diseases under control. With the advent of hot, dry weather vigilance is often relaxed, and the period between sprays is unduly lengthened in the belief that all will be well while the weather lasts. It should be noted that hot, dry conditions favour the increase of scale insects, red mite, codling-moth, leaf-hopper, &c.; and where the frequency of sprays is not maintained one or more of these pests may gain a substantial hold. If the period between sprays passes well beyond the point at which the previous spray ceased to be protective, an unexpected precipitation of moisture may be experienced before a further protective spray is applied, with the result that much of the fruit may become affected with black-spot.

It becomes increasingly difficult to obtain a complete coverage as the density of the foliage increases. It is at this time that the benefit of an open-framed tree with a clear centre is appreciated. Each tree should be thoroughly sprayed, care being taken to see that the undersides of the leaves as well as the tops receive a coating of spray, as it is the habit of the red mite and leaf-hopper to frequent the undersides. Greater efficiency is secured by the application of sprays at a suitable pressure, and where it is low the pressure should be increased if possible, to at least 200 lb. at the nozzle.

For control of the various pests and diseases the sprays as recommended in last month's notes should be continued. From mid-December the strength of the lime sulphur given in the combination spray for apples should be reduced to 0·083 per cent. For the early summer treatment of red mite or leaf-hopper the addition of nicotine sulphate 40 per cent. at 0·05 per cent. to the combination spray is advised. The application of summer oils at 1·5-per-cent. dilution is not recommended until about mid-January on account of the frequency with which sulphur sprays are applied up to the New Year for disease-control. At least fourteen days should elapse following a sulphur or lime-sulphur spray before applying an oil spray.

Cultivation.

The cultivation recommended in last month's notes should be continued. If dry weather conditions prevail the use of the harrows is sufficient to maintain the tilth, but following wet weather it is advisable to make use of the cultivator or disks. Where cultivation has been maintained it is not necessary to make a ploughing at this period, and generally it is not a sound practice to do so, as excessive drying of the soil usually follows, unless the ground is thoroughly worked immediately following each day's ploughing.

Thinning.

During the coming month the second and further thinnings of the fruit should be pushed ahead according to variety and class of fruit. Where heavy crops have set care should be taken to see that the thinning is adequate. Most growers are aware of how unsatisfactory it is to harvest and market small fruit, which is expensive to handle. Small fruit can be obviated by systematic thinning. It is seldom that a grower over-thins his fruit, as

he usually concentrates his mind on what he has removed instead of the number of fruits still remaining upon the tree, and this causes him to err in leaving too much fruit upon the tree. However, no attention should be paid to the quantity removed: it is what still remains on the tree that should concern him.

Fireblight.

As advised in last month's notes, a careful watch should be kept for any signs of infection, and the time of thinning presents a further opportunity of detecting infections.

Handling the Crop.

The earlier varieties of stone fruit will shortly be ready for picking. The picking-receptacles and ladders should be now put in order so as to be in readiness when harvesting commences. Stone fruits require careful handling, and should not be roughly picked and tipped into boxes. Benzine-tins cut the wide way and provided with clips and suitable straps make excellent picking receptacles. They are easily kept clean and free from disease. Sufficient tins should be provided for picking. Pickings should be frequent, and the fruit gathered at the stage known as hard ripe, which will enable the fruit to open up in the market in firm condition.

Careful grading and packing of the fruit into good clean cases is desirable, and for long-distance transit it is advisable to pack the larger fruit in trays. Stone fruit in trays almost invariably opens up in better condition and with less bruising than fruit in cases, and consequently realizes greater profit.

The use of second-hand cases for stone fruit is not recommended, as it is frequently the means of fruit becoming infected with brown-rot during transit. All diseased and rotting fruit should be promptly gathered and destroyed and not left hanging on the trees or lying about on the ground.

General.

In many districts the practice of growing cover crops, such as blue lupins, field peas, beans, vetches, &c., is not as general as it should be. The turning-under of cover crops not only increases the organic matter in the soil, but improves its mechanical condition, increases its power to retain moisture, and makes for easier cultivation. An adequate supply of humus greatly improves the soil fertility, and too many of our orchard soils are deficient in this respect. As the cover crop should be sown early in January to attain maximum growth before being turned under in the autumn, the necessary arrangements for seed-supply should be made shortly.

Case material should be secured as early as convenient and wet days utilized in making up a supply of cases, which can be stacked and allowed to season.

Grading-machines should be overhauled, cleaned, and put in readiness for operation; packing benches, lidding-presses, and rubber stamps should also be given attention. Wiring-machines should be sent for overhaul so that vexatious delays may be obviated at the commencement of the season. Orders for packing-material and supplies should be placed early and requirements carefully estimated.

—R. G. Hamilton, Orchard Instructor, Hamilton.

Citrus Notes.

The main blossoming of lemons in most districts will be now well advanced. As soon as the young fruit is showing it is advisable to spray with Bordeaux mixture (3–4–50) for control of verrucosis and scab, while any older fruit badly affected with disease should be removed and destroyed.

Where scales and thrips are in evidence spraying should be carried out with a summer-oil at a strength of 1–33 for red scale and for other scales 1–80

during the months of January and February. Spraying with lime sulphur 15 per cent., polysulphide content 1–40, or nicotine sulphate 40 per cent. 1–800 will assist in the reduction of the citrus-thrip infestation.

Young borers will now soon be active, and where the withering of the leaves is noticed the twig should be removed and the borer destroyed. The larger limbs may be treated by the injection of a drop or two of benzine into the holes and plugging with soap.

The long, wet period experienced in the Auckland district has soaked the subsoil and has benefited the trees. Every endeavour should now be made to attend to the cultivation. The ground immediately around the trees, as well as the "lands" between the trees, should be worked up to a fine tilth. Care, however, is necessary to avoid seriously damaging the feeding roots. Any sickly trees should be examined carefully for signs of collar-rot or bark-blotch, and affected trees should be treated by removing all the diseased bark, together with a small portion of healthy bark round the edges, after which it is advisable to paint the wound with Bordeaux paste or coal tar. This treatment will help to bring the trees back into a healthy condition. All citrus groves should be well drained, as insufficient drainage is often the means of the trees becoming infected with collar-rot in a wet season like the one just experienced. Where bark-blotch or other diseases are not found the roots of unthrifty trees should be carefully examined to determine the cause of the trouble so that the proper steps may be taken to rectify it so as to bring about good root-growth again.

The treatment of young trees should not be neglected, and all shoots arising at a low position on the trunk should be removed. Stong, perpendicular shoots not required for developing the framework of the tree should be cut back to induce lateral fruiting-growth.

Any budding required may be done during the month of November, or may be deferred until the autumn. When the work is done in the spring the shoots may be headed back to the bud at New Year, when good wood-growth may be expected to develop during the autumn.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Seasonable Culling.

From now onwards for the next few months accommodation on many poultry-plants will be taxed to its utmost. Overcrowding must be avoided if the best results are to be obtained, and the young, growing stock need plenty of perching-room if the desired development is to take place. It is a much wiser plan to rear a few birds well than a large number indifferently. The main problem is the difficulty of providing sufficient space for the growing birds.

Culling should be practised all the year round—*i.e.*, any unprofitable birds should be disposed of as soon as they are detected.

At the present time good "boiling" hens are commanding a fair price, and it would pay many poultry-keepers to go carefully through their flock, handle any doubtful specimens, and cull out birds that are not likely to be profitable. Now while the prices are good it is better to sell birds that are only producing two or three eggs a week.

The poorer birds usually are those that spend a good deal of time on the perches, having slow and sluggish movements, and in many cases the heads are either coarse and fat or long and weak.

Adult Leghorns with yellow legs and beaks at this time of the year may be culled, as it is an indication that they have not been producing for some time. At this period the heavy layers will have pale or more-or-less flesh-coloured legs and beak. The eyes of the poor producer are usually

small, dull, and sunken, with the comb small and shrunken, while with the heavy layer the eyes are generally large, bright, and prominent, and the comb warm and waxy.

When a poor layer is handled it will be noticed that the abdomen is coarse and rather hard, with a layer of fat beneath the skin, the pelvic bones being thick and stiff, whereas with the heavy producer the abdomen will be soft, thin, and pliable like the udder of a good-milking cow, and the pelvic bones thin and pliable.

The vent of the non-producer is usually small, round, and dry, but with the laying hen it is large and moist. If a regular system of culling is practised, both in regard to the old and young stock, the cost of production is reduced and more room is available for the more valuable growing birds.

Marking of Young Stock.

As there is no definite way of telling the age of fowls, it is a wise plan to mark all young stock before they get too old. This is more necessary on a farm where in many cases birds of all ages run together. The usual method of marking chickens is to punch a hole in the web of the foot, which is usually done just after they are hatched and before placing them in the brooders, suitable punches for the purpose being obtainable at a small cost. Fifteen separate or different markings can be made in this way, and a register kept of the different strains.

For marking farm flocks a good idea is to procure a supply of pig-rings, nip the sharp points off, and place one on, for instance, the left leg of all birds hatched this season, and then next season's can be marked on the right leg, which will enable the older birds to be picked out without difficulty when the time comes for selecting the breeding-stock and culling those past the age of usefulness.

Broody Hens.

As this is the time of the year when broody hens are most plentiful it is wise to visit the poultry-houses each night and remove to "broody" coops any hens found on the nests. If this is done regularly and all hens removed from the nests when they show the first signs of broodiness, in most cases the broodiness is put off in three or four days; but if the hens are allowed to sit on the nests for two or three nights it takes much longer to break the desire to sit, with the result that there is a greater loss in egg-production. While hens are in the broody coop they should be supplied with ample food and water. Cases have been known where such hens are more or less allowed to starve, but this is a mistake, as the object should be to encourage them to lay again as soon as possible, and this can best be assisted by treating them well while in the "broody" coops. An illustration of a good style of "broody" coop is shown in this Department's Bulletin No. 66, "Utility Poultry-keeping," and measures 6 ft. long, 2 ft. high in front, and 19 in. at the back, being divided into three compartments. The floor is of $\frac{1}{2}$ in. wire-netting, the sides having $\frac{3}{4}$ in. netting, and is 8 in. from the ground. The roof and back are covered with waterproof material.

Green Feed.

Though the fowl-pens may contain grass, in many cases, owing to being over-run with poultry, the green stuff will be contaminated and hardly fit to eat. In such cases fresh green feed should be supplied each day. Some poultry-keepers fail to realize the importance of a regular and liberal supply of green feed for their poultry. It is a fowl's natural tonic and has much influence on the development of young stock. When one sees hens that have not laid an egg during the winter months brighten up in comb and begin to lay when spring returns with its natural supply of green feed, and geese gather their living, lay eggs, and rear their young on young succulent green stuff, one must realize the importance of this item of food in the securing of the best results.

Where poultry are kept in limited areas and have only very small yards in which to run such yards soon become tainted and stale. In many such cases it would pay the poultry-keeper better if he were to keep his birds on the intensive system (provided he allowed each bird at least 4 square feet floor space). The small run could then be used for growing a rotation of green feed, which could be fed to the birds each day.

About one-third of the entire ration for poultry may consist of green stuff, but it is not sufficient to give quantity, as quality is also needed, and green material should be fed in such a way that it will be most relished by the birds. Silver beet, kale, rape, chou mollier, young green oats, Cape barley, and water-cress are all good. Carrots, swedes, and mangels are amongst the best of the roots, and can be fed when other green feed cannot be had. A patch of lucerne, if it can be established, proves a valuable asset on a poultry plant, as it continues to grow for years and to produce heavy yields of green feed from early spring until about April; it may also be made into hay and chaffed for winter use.

Hens that have not been supplied with sufficient succulent green feed usually produce eggs containing very pale yolks. The offspring from birds that have been short of green feed may show signs of deficiency, such as leg-weakness, toe-picking, cannibalism, feather-pulling, or crooked beak-bones, and it therefore pays poultry-keepers to see that their birds are supplied regularly with a good variety of succulent green feed.

—C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Requeening.

THE most important bee within the hive is the queen, and it is futile to expect a colony to be productive unless the queen is a good one. It therefore is highly essential that all colonies should be headed with prolific queens of a good strain if vigorous workers are to be raised. Queen-rearing is an important adjunct in apiary-management, and unless provision is made to requeen systematically the beekeeper will find dwindling colonies and diminished crops. Where practicable, it is advisable to requeen the colonies every year. Exception, however, must be made in the case of hives containing breeding-queens, and others retained on account of desirable drones.

Where the operations of the beekeeper are such as to prevent annual requeening, provision should be made to replace half the queens in the apiary each year. If this plan is followed no colony will have queens more than two years old. With the aid of a few nuclei, young queens can easily be hatched and mated, but in many cases—especially where a swarm has emerged from a hive—virgin queens can be secured and form an easy solution of the requeening problem.

No better plan can be followed by the beginner than to utilize queen-cells produced naturally—that is, under the swarming impulse. It has been proved that in New Zealand the best months for raising queens are from November to January. During this period everything is favourable to the operation, as the hives are at their highest state of prosperity. Under normal conditions the workers and drones are at their best, this being the swarming-period. There is practically no risk of robbing; the young queens are readily accepted and tend to reduce swarming. Moreover, a queen introduced during the months of prosperity produces numbers of young bees for the winter, and still is fairly young in the following spring. In the case of after-swarms, these may be sifted through an excluder placed between two empty supers, when the queen or queens can be removed. The bees then return to the parent hive.

These young queens can be utilized for starting nuclei. It always seems a pity to destroy the young vigorous queens bred under the swarming-influence, and wherever there is an opportunity they should be saved and failing queens destroyed. A handy method of introducing virgin queens is by the smoke method. The old queen must first be removed from the hive that is to be requeened. The entrance then is contracted, and a few vigorous puffs of smoke are forced in through it. Then, before the bees have recovered from this treatment, the virgin queen is released at the entrance, piloted into the now queenless hive, and hastened therein by several more puffs of thick smoke. The hive is then closed altogether for about ten minutes, after which the entrance is once more opened slightly and left like this till the next day, when the full entrance can once more be allowed.

Extracting Preparations and Practice.

Preparations for extracting the honey must now be well in hand. By the time these notes are published the main flow should have started in the North, but this depends entirely upon weather conditions. In the South the flow is fully three weeks later, and extracting rarely commences before the New Year.

It is well to have all the arrangements for handling the crop completed before the honey is sealed and ready for the extractor. It does not take a great deal of time to prepare extra supers and frames, but these are of inestimable value to the beekeeper when the main flow commences. Every year immense quantities of honey are lost through lack of proper equipment for handling the crop, or through the unreadiness of the beekeeper when the hives are full of honey. It is poor economy to keep one's supply so low that the bees remain outside the hive and loaf for want of combs in which to store the honey.

Room should be provided for the workers as soon as the first honey is capped, either by extracting the combs or by supplying another super. Keeping the extractor running from the beginning of the honey-flow till the end is good beekeeping, provided the honey is not extracted while in an unripe condition. Although some authorities advocate leaving all the honey until the end of the season, thereby building colonies three and four stories high, the result is rather heavy work, and in any case, this method is not advisable in southern localities. Where the summer is short and variable the risk of the honey becoming chilled by its being left in the hives until the end of the season is too great. Honey, except in a few instances, is best extracted when warm; in fact, where there is any tendency to "thick" honey, extracting while the honey is warm is the only way to obviate breaking the combs in the extractor.

Comb-honey should be treated in the same way. All sections should be removed from the hives as soon as they are filled. This makes them less liable to be daubed with the propolis and to become "travel-stained" by the constant passage of the bees.

The extractor, tank, and all the rest of the gear connected with the handling of honey should be scalded and thoroughly dried before commencing the season's work. Honey, by reason of its peculiar method of production, does not call for the daily cleansing required by other foods, but it behoves the beekeeper to see that his honey-house is as trim as hands can make it. After the extractor has been scalded it should be kept covered with a clean washing-cover when not in actual use, and every receptacle containing honey should receive the same treatment. These covers are easily made and washed, are inexpensive, and add much to the condition of honey as an article of food. No bees, flies, or any extraneous matter should be allowed to touch the honey once it leaves the extractor, and from the time the bees gather it till it leaves the beekeeper's hands for market his aim should be to produce a dainty and attractive article of food.

Extracting-appliances.

It is most inadvisable to try to work bees profitably without proper appliances. These consist of an extractor, uncapping-knives, uncapping-can, and settling-tanks. Many beekeepers make the mistake of trying to get along with any make-shifts, but experience teaches that it is a poor policy to endeavour to operate without an up-to-date equipment. However small the number of hives kept, if extracting is the objective it is most profitable to install a four-frame machine. Costing a little more at the initial outlay, it soon pays for itself in labour-saving and enables the beekeeper to meet the biggest flow. In any case, he should not be persuaded to purchase a machine that does not reverse. Fixed machines are labour-makers, besides being messy in working. When fifty or more colonies are worked a power-plant pays for itself over and over again.

Second in importance is a good tank. No apiary equipment is complete without one or two good tanks. Too little attention is paid to maturing the honey when out of the hive and freeing it from the minute particles of wax which float on its surface. It must be left to the beekeeper to decide the size of tank he requires, this depending on his needs and conveniences.

For rapid working two ordinary uncapping-knives are very convenient, but as yet no better invention has been given to the beekeeping world than the steam-heated knife. This knife obviates the necessity of constantly dipping the cold knives into hot water, and the work of uncapping can proceed uninterruptedly. There are several uncapping-cans and melters on the market, most of which are relatively satisfactory, but the perfect capping-melter has yet to be invented.

Treatment of Disease.

If the weather conditions have not been favourable for the treatment of foul-brood, this should be undertaken when the first opportunity occurs. One should not delay until the main flow arrives. It is well to remember that if colonies are treated early enough a surplus of honey is secured and the expense of treatment recovered. Handling clean bees is a constant source of delight, but diseased bees are a never-ending cause of trouble. Full particulars of the treatment of foul-brood are given in Bulletin No. 119, "American Foul-brood and its Treatment," which may be obtained free from the Department of Agriculture, Wellington, or from the Apiary Instructor in each centre.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

LAND from which crops of early potatoes, peas, and salads are harvested is now cleaned up and planted with winter crops. If the preparation for the previous crops was liberal and thorough, light cultivation is all that is necessary now before planting. Leeks, kale, broccoli, Brussel's sprouts, and savoys are suitable for the cooler districts. In warmer localities cauliflowers, which have the advantage of maturing quickly, may be planted in preference to broccoli. On land that is moist but well-drained self-blanching varieties of celery may be planted out 9 in. apart in long beds 2 yards or 3 yards wide, with the surface at ordinary levels. In drier localities and on land that is over-drained it is necessary to plant celery in trenches, which facilitate frequent irrigation. As rather long periods of dry weather are often experienced at this season it is necessary to plant out these crops with considerable care, choosing dull weather, before rain, for the work. The seed-beds should be soaked well the day before lifting the plants, which should be taken up carefully, as required, and placed in trays. They should not be exposed to sun and wind. In the field the plants should be set low and

watered at planting. To prevent the attack of caterpillars during the present stage of growth an application of a dust composed of one part arsenate of lead-powder thoroughly mixed with five parts of hydrated lime is effective if applied during the evening, or in the early morning when the foliage is damp. Chiefly, plants of the cabbage family require this attention. To prevent aphides becoming established and destroying the central bud, which sometimes happens to cabbage-plants, a pinch of tobacco-dust is effective. Leeks have few troubles to contend with, but the celery crop requires to be kept under close supervision for leaf-spot fungus attacks, and usually requires occasional applications of Bordeaux 3–4–50 to prevent this. The lime ingredient in this mixture may be replaced by washing-soda, using sufficient to make a neutral mixture. A large number of moderate-sized specimens of good texture and flavour should be the object in the production of these crops; over-sized specimens without much quality are sometimes commended, but they compare unfavourably when it somes to practical use.

During dry periods runner beans often fail to set the pods satisfactorily, and then a light spraying with clean water after sunset is beneficial. Those planted against walls and fences are most likely to suffer in this way. In such a position the roots also are likely to lack moisture owing to the limited rainfall which reaches them; a good soaking occasionally and a mulch of dry litter on the surface of the ground usually supply their needs in this respect. Marrows and other gourds are also seriously affected by a lack of moisture and require attention during dry periods. Marrows are at their best when cut small before they ripen: the vines also are more productive under this treatment.

Further sowings that might be considered during the month of December are dwarf beans, peas, shorthorn carrots, and lettuce sown thinly to mature where sown; radishes and quick-maturing white turnips.

A cleansing fallow for weedy ground requires close attention now to take full advantage of dry periods; if this is done clean ground and a good autumn crop are the probable rewards.

Early in the month of December most of the plants forming the rough growth in odd corners and hedge bottoms are in flower and in suitable condition for mowing. They should be cut close with a weed-scythe and allowed to lie on the ground as a mulch.

Small Fruits.

A most serious fault in fruit-packing is to pack specimens of mixed stages of maturity in one parcel—this is avoided chiefly by clean picking so that no over-ripe specimens are available to stain and spoil the appearance of the pack. Honest packing and an appetizing appearance are important factors in selling these products. Difficulties are more likely to arise in the harvesting and marketing of strawberries than of any other of the small fruits. Packing of stawberries is done by the picker as the fruits are gathered, and one who is inexperienced will rather naturally "face" a pack to give it good appearance; and so long as this consists of a neat arrangement of the surface fruit in the punnet it is quite legitimate and desirable, but the size and quality of the fruit should be similar to that which is below. Clean punnets well filled with fruit of an even grade are always in good demand. Berries that are undersized, misshapen, or over-ripe must be placed in a separate receptacle and are suitable for culinary use. Firm fruit only should be consigned for long distances; specially is this precaution necessary during hot weather. Strawberries are picked with a short stem attached, raspberries and loganberries are removed from the plug, and currants are "strigged" when gathering the ripe fruit. To enable it to retain a bright, fresh appearance that is so desirable the fruit should be dry and cool when gathered and always given cool conditions until consumed. The close-stacking of large bulks and delay in collecting packed punnets in the field

are likely causes of heating. Furthermore, it always is to be remembered that these goods are perishable, even when all precautions are taken, so that it should be always a rule to market the fruit on the day it is gathered.

Weak and surplus suckers on raspberries and loganberries should be suppressed: this has the effect of invigorating and ripening those new growths retained for cropping next season.

Identification of Raspberry Varieties.

The best varieties of raspberries have outstanding qualities, and when the fruit of a variety is unmixed with others it can be used to best advantage and crop-management is facilitated. The confusion which exists in the identification of many varieties of raspberries is being tackled by the staff of the Horticultural Research Station, Long Ashton, Bristol, who have had a long experience of variety trials with fruit of this kind.

In a recent report the following key for variety identification is presented,—

(1) *Mature Cane Colour.*—The varieties are first divided into three colour-groups according to the colour of the mature canes: Red, light brown, and white.

(2) *Colour of the Spines on Young Canes.*—Only canes that have made one foot or more of growth can be regarded as reliable when comparing spine-colour. Spines are defined as dark or pale in colour. During winter the only feature by which varieties can be grouped is mature cane-colour, but for a period during the summer season this character can be used in conjunction with the spine-colour on growing canes. In this connection it is interesting to see the spineless variety Northumberland Fillbasket is classified with white cane, pale spine varieties.

Other distinguishing characters are—*Canes*, which may be dwarf or medium-vigorous; erect or spreading. *Leaves:* Colour-shade and habit are noted. *Fruit:* Season, shape, colour, and flavour are the outstanding points.

For instance, the variety Semper Fidelis is described as—(1) Mature canes, red; (2) spine-colour, dark. *Canes* of medium vigour, spreading. *Leaves* medium-dark green, fairly flat. *Fruit:* Mid-season, medium size, conical, deep red, sharp flavour. Also the variety Lloyd George—(1) Mature canes, white; (2) spine-colour, dark. *Canes* vigorous, spreading. *Leaves* somewhat shiny, medium-dark green. *Fruit* early, large conical, fairly firm, variable colour, moderate flavour.

This key to varieties is simple and practical and cannot fail to be of value to growers of raspberries.

The Homestead Garden.

To fully exploit conditions of soil, climate, &c., with a minimum of labour and most effect, the extent of the garden should be proportioned to the size of the homestead, and the design should be compact, with each section well organized. The formality of many old-fashioned gardens has been severely criticized. Where it was extreme and extensive, as sometimes happened, it could certainly become very tiresome. However, there is another extreme of which there are too many examples here: it is an informal rustic style that can only be described as chaotic. Whatever opinion one may have about it, the main point is that the labour of maintenance of such a garden is very great. Good results, requiring the least amount of labour for maintenance, may be obtained by planning a simple, well-proportioned design in which vegetable and fruit garden, shrubberies, and herbaceous borders have each their well-defined limits. And the latter—that is, the shrubberies and herbaceous borders—are planted with rather large groups of each kind of plant. A desirable amount of informality is

obtained by adding one or two specimen trees or detached groups of herbaceous plants or shrubs. In such a garden unskilled labour may be used to advantage and with little danger of damage being done.

Making new gardens or alterations to old ones is best done during the autumn or spring, hence the present time is most suitable for planning the work, the quality of which depends very much on the previous consideration given to it. It is best planned in detail, and, if to scale, the work, when it comes to be done, is greatly facilitated.

The most difficult, and perhaps the most interesting, feature in the work is the selection and arrangement of the trees, shrubs, and plants. This is successful—that is, effective and economical—when the plants are quite suited to their environment, as regards climate especially. Whether it be humid or dry, cold or warm, shaded or sunny, sheltered or exposed to winds, there is a very varied plant association suited to each condition, and one is wise to exercise personal preferences within that group. In most districts this has been thoroughly well demonstrated now, and careful observation in established public and private gardens in one's vicinity, or in similar country, will afford the necessary information. One principle which is generally endorsed, but frequently forgotten in practice, is that the background and many of the outstanding features in the garden should consist of native plants. For the former purpose our native evergreen trees and shrubs cannot be excelled; while for the latter our tree-ferns, nikau palms, cabbage-trees, lancewood, and flowering trees and shrubs cannot be ignored. In a warm locality on the coast, even in an exposed position, the karakas and pohutukawas almost alone would furnish a small garden handsomely if suitably arranged. There is nothing finer than these, in their class.

About the verge of established plantations and among the young trees in new ones, at the foot of hedges and in odd corners where high grass and herbage has grown, it should be carefully mown now and allowed to lie as a mulch. It not only improves the appearance of the property, but increases fertility, lessens the danger from fire, and its cutting is of great assistance to young plants and hedges by admitting more light.

—W. C. Hyde, Horticulturist, Wellington.

NORTH ISLAND LAMBING ESTIMATE.

FROM information furnished by Inspectors of Stock in the various districts the average lambing for the current season in the North Island is estimated at 83·68 per cent., compared with 89·88 per cent. in 1934. With 9,697,231 breeding-ewes in the North Island, as shown in the 1935 sheep returns, the number of lambs this season is estimated at 8,114,361. South Island and Dominion returns will be given in next month's issue of the *Journal*.

DEPARTMENT OF AGRICULTURE.

WALLACEVILLE POULTRY STATION.

FOR SALE—

WHITE LEGHORNS

10-weeks-old Pullets, and
Hens terminating First Laying Season.

For full particulars apply—

THE POULTRY OVERSEER,
Veterinary Laboratory, Wallaceville,
per Private Bag, WELLINGTON, C. 1.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

TREATMENT OF GROWTHS ON SKIN OF HEIFERS.

A. R. H., Waiuku :—

A heifer has large wart-like growths on its body, particularly on its head and flanks, and another heifer has small warts on its neck. The heifers seem to be quite healthy otherwise and are thriving as well as their mates.

The Live-stock Division :—

Warts in young animals usually disappear without anything being done to them, but larger warts may require to be cut out. You may be mistaking ringworm for warts. Dressing each spot with a swab saturated with kerosene, Jeyes fluid, or Camfosa will kill the ringworm. It is advisable to be careful that none of the strong application gets into the eyes; one application is usually effective. An alternative treatment is to wash them with a fairly strong solution of sheep-dip, according to the instructions on the label. If it is not desired to adopt the above treatments the following can be used: Sulphur and olive-oil, or sweet-oil, or, in the absence of these, raw linseed-oil will do. Take 1½ oz. of sulphur (flowers of sulphur) to 1 pint of oil, work it into an emulsion and shake well, and add 2 tablespoonsful of kerosene. This may be applied every fourth day.

SPECIAL FEED FOR EWES IN SPRING.

F. J. F., Ohura :—

Please advise the value of rye-corn as a supplementary feed for ewes during August and September; when it should be sown; amount that should be sown per acre (broadcast); and the kind and quantity of manure necessary.

The Fields Division :—

Whether the growing of catch-crop cereals for spring feeding of ewes is worth while depends on many circumstances; under general farming conditions the feed for this period is best supplied by top-dressed rye-grass pastures, and a pasture-improvement programme is probably the best means of improving the spring feed position. If special crops are grown, Algerian oats, Algerian oats and Italian rye-grass, black skinless barley, or black skinless barley and Italian rye-grass are better than rye-corn. These crops should be sown in March or April for feeding in July, August, or September. It is advisable to sow 4 bushels of either oats or barley alone, or 3 bushels of oats or barley and 15 lb. Italian rye-grass with 3 cwt. superphosphate.

TESTS FOR CONTAMINATION OF MILK.

H. B. I., Norsewood :—

Is there any simple method whereby I could test milk for contamination by, for instance, using a sample from the holding-vat before separating?

The Live-stock Division :—

Milk can best be tested for the presence of dirt by use of a so-called sediment tester. This is an instrument by means of which a pint of the milk to be tested is forced through a small round pad. The pad retains any dirt present so that it can readily be seen. The Methylene blue test gives an indication of bacterial contamination, and this, indirectly, provides an indication of the amount of dirt contamination.

WEATHER RECORDS: OCTOBER, 1935.

Dominion Meteorological Office.

NOTES FOR OCTOBER.

OCTOBER can be regarded as having been a favourable spring month, the main features of which were the generally mild temperatures and a plentiful rainfall, especially in the last ten days. The rain in South Canterbury relieved the fear of severe loss through the prolonged dry weather, and by the close of the month crops and pastures had made a good recovery in that district. Over the greater part of the Dominion there was a vigorous growth of vegetation, and consequently stock are in splendid condition and dairy production has increased appreciably.

Rainfall.—The total rainfall was above the average over most of the North Island, but below in the northern part of the Auckland Peninsula and at a few isolated places in the Gisborne, Hawke's Bay, and Taranaki districts. In the South Island an excess was recorded north of Greymouth and Akaroa, while farther south there was a deficiency.

Temperature.—Temperatures were nearly everywhere above the average, although the departure was nowhere a great one. In the coastal area between Wellington City and New Plymouth and at Invercargill it was very slightly below, while in North Canterbury it did not vary much from the average. Christchurch experienced a frost of 9 degrees on the morning of the 20th and one of 8 degrees on the 16th, but otherwise there were no severe frosts during the month, many districts reporting none at all.

Sunshine.—Owing to a considerable amount of dull weather during the latter part of the month, sunshine was less than the average in most districts, the only excess being experienced in North Auckland, the east coast districts south from Christchurch, and in Southland.

Pressure Systems.—Up till the 13th, although temporary changes to south-westerly occurred in places, the winds were mainly north-westerly or westerly. What little rain fell during this period was confined mostly to the western and far southern parts of the South Island, the weather remaining fair and warm in all eastern areas.

During the night of the 13th a rather deep depression crossed the Dominion, and by the morning of the 14th winds had become south-westerly or southerly generally, rain accompanying the change in most districts, with a drop in temperature. The rainfall was only light and scattered in most of the eastern districts. A slight secondary which crossed the central portion of the North Island on the 16th was responsible for thunder and hail at places between Taranaki and the East Coast district of the North Island. During the next two days, while an anti-cyclone was crossing the Dominion, fine weather prevailed generally.

On the 19th a southerly change in the night brought rain, though chiefly light falls, to most districts.

The morning of the 20th was marked by an improvement setting in generally. The 21st was a brilliantly fine day over most of the Dominion, but by the morning of the 22nd an extensive and complex depression was approaching from the westward. The latter was the most important depression of the month as it was responsible for warm, beneficial rains throughout the Dominion during the night of the 22nd and from the 23rd to the 26th. Improved conditions were in evidence on the 27th. On the 28th conditions became unsettled in western areas, with scattered rain. By the morning of the 29th this disturbance had greatly intensified and its centre was located east of the South Island. It had passed beyond effective range on the 30th, but a new cyclonic depression had moved from the north-west on to the North Island. Dull, misty weather prevailed on the last two days, heavy rains occurring in the North Island and parts of the East Coast districts of the South Island.

RAINFALLS FOR OCTOBER, 1935, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
	Inches.		Inches.	Inches.	Inches.	Inches.
North Island.						
Kaitaia	4·66	15	1·48	5·27	61·89	48·93
Russell	3·03	7	1·66	3·98	85·47	45·17
Whangarei	2·92	17	0·71	4·76	73·10	54·71
Auckland	4·12	17	0·87	4·06	54·71	42·58
Hamilton	5·38	16	1·76	4·60	42·07	42·03
Rotorua	5·24	18	1·18	5·19	60·09	47·10
Kawhia	5·56	13	1·20	5·15	..	45·90
New Plymouth ..	7·18	20	1·36	5·46	67·64	50·79
Riversdale, Inglewood ..	14·28	22	3·47	10·41	103·63	87·57
Whangamomona ..	12·34	17	3·91	8·43	75·31	64·53
Hawera	4·11	16	0·98	4·65	50·36	38·18
Tairua	5·32	12	1·75	5·81	67·11	56·44
Tauranga	6·11	19	2·42	5·11	57·19	45·52
Maraehako Station, Opotiki	6·48	12	3·06	5·35	64·19	47·29
Gisborne	2·40	12	0·84	2·67	41·07	39·95
Taupo	4·65	17	1·15	4·31	46·46	37·43
Napier	3·55	14	1·46	1·89	46·43	26·12
Hastings	1·59	12	0·38	2·11	36·13	28·16
Whakarara Station ..	4·38	7	0·86	..	56·61	..
Taihape	3·47	19	0·58	3·50	31·64	30·06
Masterton	4·28	18	0·59	3·24	40·00	32·78
Patea	5·87	17	1·08	4·25	49·69	37·28
Wanganui	6·32	17	1·44	3·46	38·42	30·18
Foxton	4·77	16	1·00	2·94	32·33	26·67
Wellington	5·12	18	0·85	3·51	34·81	36·38
South Island.						
Westport	10·00	20	1·56	8·70	76·77	88·35
Greymouth	9·12	19	1·60	10·74	80·93	83·90
Hokitika	8·58	20	1·48	11·81	91·30	94·12
Ross	8·75	15	2·00	14·77	95·64	109·48
Arthur's Pass ..	14·24	17	3·00	20·33	108·97	131·69
Okuru, South Westland	9·46	12	2·05	15·21	87·33	120·90
Collingwood	17·67	19	5·94	10·08	88·38	82·03
Nelson	6·64	13	2·78	3·50	41·13	31·94
Spring Creek, Blenheim	2·60	13	0·65	2·56	24·71	25·79
Seddon	3·59	15	0·84	2·23	19·97	20·99
Hanmer Springs ..	5·90	13	1·13	3·92	36·03	37·83
Highfield, Waiau ..	5·03	11	2·20	2·60	27·01	28·12
Gore Bay	4·19	9	0·91	2·33	22·75	26·58
Christchurch	2·90	11	0·84	1·97	18·67	20·89
Timaru	1·62	7	0·64	1·98	15·81	18·31
Lambrook Station, Fairlie	2·26	10	0·72	2·06	17·31	20·37
Benmore Station, Clearburn	2·52	11	0·84	2·30	18·21	20·25
Oamaru	1·77	10	0·81	1·76	15·80	17·84
Queenstown	2·03	11	1·12	3·31	25·52	25·28
Clyde	0·83	6	0·26	1·62	12·59	12·12
Dunedin	2·74	9	1·42	3·09	29·91	29·97
Wendon	1·24	9	0·38	2·73	26·37	24·42
Balclutha	1·45	12	0·35	2·42	25·85	20·58
Invercargill	2·00	20	0·41	4·35	39·16	37·37
Puysegur Point ..	7·37	28	1·30	8·13	72·39	69·84
Half-moon Bay ..	7·47	23	2·55	5·16	50·80	48·10